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Editorial Contents for July, 1929

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The Los Angeles Convention

WITH a registration of over 500 railroad men, the Mechanical Division convention at Los Angeles must be considered a successful meeting. The arrangements for the entertainment of the members and guests, as well as the arrangements for the convention itself were such that those who attended will have nothing but pleasant recollections of the meeting.

The Power-Brake Investigation

Some of the reports and discussions were also of a character that make the work of the Division this year of more than ordinary interest. While the complete final report of the air brake rack tests at Purdue University was not ready in time for presentation, the conclusions which have been reached as the result of the tests were presented, and the coming year will see the development of the next major step in this important investigation—the road tests over the Siskiyou line of the Southern Pacific.

The Draft-Gear Test Report

The outstanding report of the year is that of the Committee on Couplers and Draft Gears. This embodies the complete report of the Purdue laboratory tests, and its presentation brought forth a discussion which indicates a wide-spread realization of the importance of improved draft-gear conditions.

The report is voluminous and convincing evidence of the comprehensive and accurate character of the tests, and on all sides at the convention it was commended for its impartiality. There can be no question but that the report of these tests constitute an important contribution to the knowledge of draft-gear action under laboratory conditions. They are particularly valuable from the railroad standpoint because of the stimulus they have imparted to the improvement of draft gears. In fact, most of the manufacturers whose gears were tested, have already made certain changes and improvements, as a result of the tests, designed to provide more desirable draft-gear action in one particular or another.

There was a strong undercurrent of opinion at the convention, however, that specifications developed as the result of laboratory tests alone cannot give assurance that draft gears will possess all of the characteristics needed to provide adequate car and lading protection under severe modern operating requirements. The value of a draft gear must be measured not alone by its own life and maintenance cost, but also by the car maintenance and damage claims it saves, and of these factors the latter are much the more important. It will require the accumulation and comparison of a large amount of service data before we shall be able to evaluate the characteristics of gears, as measured in the laboratory, in terms of ultimate economic value.

While the committee does not recommend road tests of draft gears at this time, its members have gears under observation on their respective roads and it has signified the intention to co-operate with the manufacturers in further study.

Train Lighting

Another subject which is very much on the minds of northern car-department and operating officers is passenger-car lighting. This year's discussion of the report of the Committee on Locomotive and Car Lighting, like that which the subject brought forth at Atlantic City last year, emphasizes the unsatisfactory service of the belt-drive in severe northern winters.

The belt drive provides reliable and reasonably economical service in by far the greater part of the United States. In northern United States and in Canada, however, belt service is not reliable during the winter months and the need for a substitute is evident. No substitute which has been discussed, however, meets all of the conditions as well as the belt-driven equipment, and the northern roads are faced with a choice between two evils. They may continue to use the belt drive and put up with frequent light failures, or they may adopt a substitute for the belt drive, such as head-end lighting or some form of chain or gear drive for axle generators. No doubt, a satisfactory degree of reliability may thus be attained, but either at an increased cost of equipment and maintenance or at a sacrifice of interchangeability where cars are required to operate over other than the home roads. The demand for reliability is paramount, however, and the sacrifice must be made until a solution along lines not yet clearly evident has been attained.

This is not a problem which is likely to be worked out by a committee. It is a problem for the inventor and the designer. Both, however, may and should be

guided by the reports of the committee and the discussions which they bring out.

President Aishton, in expressing his appreciation of the way in which the members of the various Mechanical Division committees have worked, pointed out that some of them have spent a substantial proportion of their time at hearings in Washington, serving their industry as a whole, rather than their own individual railroads. The problems requiring collective study and action are constantly growing in number and importance and more of this kind of work, rather than less, will have to be done in the future. The past records of ability to sink their differences and arrive at practical working agreements in matters requiring collective action, which have been made by mechanical department officers, suggests that the Mechanical Division will fully meet this growing responsibility.

Tie Your Railroad Into the Community

ENLISTING the co-operation of employees as solicitors of business for the railroad is not a new idea. Many railroads have been following such a policy for a number of years and with very good results. Building good will on the part of the shipper and prospective passenger is a fundamental principle, not only in the securing of new business, but retaining the old. Recently, a letter was written by a local railroad officer to the members of an association of railroad men in behalf of the officers and mechanical department forces of the railroads in a certain city, requesting their support in securing the acceptance of an invitation which has been extended to the association to hold its 1930 convention in that city. Enclosed in the envelope with the letter was an attractively illustrated folder showing the many interesting attractions of the city. Surely, such co-operation on the part of the railroad officers and mechanical department forces must be appreciated by the business men of that community, and must be a considerable factor in building up good will. There are many mechanical department officers with headquarters in cities and towns on the line away from the main offices of the railroad, that have splendid opportunities to build up good will for their railroads. There are many communities in which the railroad shops are one of the largest industries, and because of that the officer in charge of the shop and the members of his staff are men of importance in their community. Activity on their part in community development is one way in which they can build the foundation for mutual respect and understanding between the public and the railroad.

Handling Perishables by Rail

THE important part played by the mechanical department in the movement of refrigerator cars from remote agricultural districts to the large centers of consumption was pointed out by several speakers at a joint meeting of the Railroad Division of the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers which was held at State College, Pa., June 21, 1929. Referring to the work done at the Jacksonville, Fla., classification yards of the Atlantic Coast Line, one of the speakers said that all of the repair work possible, such as air-brake repairs, changing journal bearings, etc., was performed without switching the cars from the train. Cars, of course, are switched out to change wheels and make draft-gear repairs. This speaker on one occasion saw a car switched from an inbound train, the wheels changed and the car returned to the same train in slightly less than 40 minutes. Another problem commented on is the waterproofing of the floors of refrigerator cars. Some shipments of green stuffs will melt as much as five tons of top ice, creating 1,200 gal. of water. This is sufficient to make a pool 7 in. deep on the car floor. Efforts are now being made to protect the floors against absorption.

All the railroad men who took part in the discussions of the six papers endeavored to show the refrigerating engineers the variety of problems in connection with the design and handling of refrigerator car equipment, and what the railroads were doing toward their solution. None of them posed as being experts on refrigeration, but they were emphatic in stating that they knew what was required to meet the needs of the shipper and consumer. Quoting one of the speakers who presented the railroad's side of the question under discussion, "Much can be accomplished if the refrigerating engineer chooses to co-operate with the railway mechanical traffic and operating officers in the solving of the many problems in connection with the transportation of perishable products. The railroad man is constantly on the alert to meet the demands of the shipper and consumer. Competition is keen and he knows what has to be done in order to get the business."

Quality Forgings

THE quality of forgings used in locomotive and car construction is a matter of prime importance to railroad mechanical departments both from the standpoint of safety and economy. Before the design of forging-machine dies had reached its present state of development, defective upset forgings were sometimes caused by attempting to gather too much stock in one blow, which resulted in buckling or folding of the metal and raised a question as to the reliability and strength of machine-made forgings. This question is seldom raised today, but, if raised, it is most effectively answered in a paper, "Some Notes on the Quality of Upset Forgings," read by E. R. Frost, president of the National Machinery Company, Tiffin, Ohio, before the Toronto chapter of the American Society for Steel Treating.

Referring to this matter, Mr. Frost said: "This defect, however, is so easily determined, and now so generally understood, that failure from this cause is rarely found today. In fact, such a failure is inexcusable, as it is now common practice to split and etch upset forgings; and should there be any defect in the grain flow resulting from bad die design, it is immediately apparent." He added: "All available evidence indicates that upsetting, properly performed, materially increases the strength of a forging. The best of the ball-bearing races are made from upset forgings, rather than from tubing or solid bars, on account of the increased quality obtained. The increase in the quality of an upset forging is particularly noticeable when a large amount of 'working' has been given by upsetting from small size

stock. In fact, many engineers today demand a maximum of upsetting or building up by the use of the smallest possible size of stock for any given forging. The added working increases the grain refinement and strengthens the forging."

Another common misconception cleared up by Mr. Frost is the assumption that tension must exist in either the outer or inner portions of an upset forging. Careful experiments and the study of etchings show clearly that compression exists throughout the entire cross section of a properly-made forging. A study of the etchings of some solid center forgings apparently indicates that the center flow lines have opened up under the action of the upsetting operation, but Mr. Frost's paper shows conclusively that this effect is simply the result of the action of the etching reagent in attacking inclusions in the steel which have been widened by the upsetting operation.

Upset forgings are occasionally criticized for the inclusion of seams which show up on the outer surfaces. These seams, however, are said to be invariably traceable to corresponding imperfections in the original bar. Consequently the forging machine operation provides a valuable check on the quality of the metal in the original stock.

Experiments and service tests, particularly in recent years, have shown the value of machine forgings because of the greater refinement of grain, advantageous radial grain flow, freedom from warping in hardening and the possibility of detecting seams and defects in the original bar stock. The responsibility of railroad mechanical department men is to see that forging dies are of the proper design and used in well-maintained, modern machines, so that the maximum benefits of this up-to-date production method may accrue to the railroads.

"Shaking Them Up"

THERE is one method of handling an organization with the object of keeping it constantly on its toes and improving its efficiency which, although now much less frequently employed than other more intelligent methods, is still in evidence on a few railroads. The motive upon which it depends to inspire greater activity and more efficiency in the organization is fear. It is the resort of officers either too weak, or too ignorant of the conditions surrounding the work of the department or of the possibilities of improvement through the co-operative efforts of a loyal force of supervisors and men, to be real leaders. It depends on a periodical shake-up in which supervisors are transferred and set back over night, in many cases with no clear understanding of wherein they have failed—if, indeed, they have failed at all under the conditions with which they have had to contend.

If the cost of maintenance of equipment and of enginehouse expense is considered to be too high on a certain division, such an officer considers that he has solved the problem when he has fired or demoted the master mechanic, or the foreman, and appointed a new master mechanic, or new foreman, who will not talk back with a suggestion that perhaps certain conditions at the shop or terminal need remedying if permanently improved results are to be expected.

It is probable that if it were to be suggested to such an officer that loyalty of supervisors and men is the most dangerous condition which can be allowed to exist in an organization and that every possible measure should be taken to discourage it, he would consider the person offering the suggestion as a fit subject for the psychopathic ward. And yet this method of handling an organization is a most effective means of destroying its loyalty. It is evident, then that such officers are misinformed as to the nature of loyalty. Loyalty is something which cannot be demanded as a condition of employment. It is something which must be paid for in kind. No man will long be loyal to a foreman, an officer, or a management which he believes is disloyal to him.

There are undoubtedly numerous instances in which bad conditions in an organization or inefficient operations within a department require drastic measures for their improvement. A shake-up in which supervisors are fired, set back or transferred to more undesirable jobs is the most drastic measure which can be taken. To adopt it as a regular means of keeping an organization on its toes represents the same kind of intelligence as would be that of a doctor whose only method of treatment was surgery, performed without an anesthetic. No doubt for a time arbitrary reductions in expense may be effected in this way, but in the end such reductions only lead to disaster. The destruction of loyalty is accompanied by a loss of efficiency, and lowered efficiency ultimately leads to an undesirable increase in expense.

In an editorial in the April issue the *Railway Mechanical Engineer* expressed its belief that there is a future for men with ambition and ability in the mechanical departments of the railroads. We believe that enlightened ideas of leadership prevail in the conduct of these departments. We cannot, however, overlook the fact that there are still officers in control of some of these departments ignorant of the true nature of loyalty and who still act on the belief that fear is the most effective motive by which men may be spurred to their utmost activity. No intelligent man should risk his future where such a belief prevails.

New Books

THE CARE AND OPERATION OF MACHINE TOOLS.—*By J. W. Barritt, supervisor of apprentices,, Westinghouse Electric & Manufacturing Company, Philadelphia, Pa. 292 pages, illustrated, 6 in. by 9 in. Price $2.75. Published by John Willy & Sons, Inc., New York.*

The subject is treated in nine chapters, which cover lubrication, the emery wheel, the drilling machine, the shaper, the vertical boring mill, the lathe, the planer, the horizontal boring mill and the milling machine. Each chapter is included with a list of pertinent review questions.

The text describes the construction of the various parts of machine tools, explains why and where adjustments are necessary and how to make them, gives directions that will enable the beginner to operate the different mechanisms without endangering himself or injuring the machine, and emphasizes the precautions that must be observed if the operations are to be performed correctly with the accuracy, neatness and speed that are required by present-day conditions in trade and industry.

R. H. Aishton, President of the American Railway Association, making the opening address at the tenth annual meeting of the Mechanical Division held at Los Angeles, Cal.—Those seated are V. R. Hawthorne, Secretary of the Association, A. R. Ayers, Vice-Chairman, and G. E. Smart, Chairman of the Mechanical Division

Mechanical Division Meets at Los Angeles

A three days' program of reports and addresses—Complete report on draft-gear tests and preliminary report on air-brake tests

THE Mechanical Division of the American Railway Association held its tenth annual meeting at the Hotel Alexandria, Los Angeles, California, Tuesday, Wednesday and Friday, June 25, 26 and 28, 1929. Thursday, June 27, was devoted to an all-day outing at Catalina Island. The chairman, George E. Smart, chief of car equipment, Canadian National Railways, called the sessions to order each day at 9:30 a.m. The sessions on Tuesday and Wednesday continued through to 5:00 p.m., with a recess for lunch. The work of the Division was completed and the meeting finally adjourned at the close of a half-day session on Friday.

The session on Tuesday morning was opened with an invocation by the Rev. John M. Baxter, pastor of the Rosewood Methodist Church. Following the invocation the members and guests of the Mechanical Division were formally welcomed to Los Angeles by William G. Krowl, assistant city prosecutor, representing Mayor George Cryer. Following Mr. Krowl's address, chairman Smart called on R. H. Aishton, President of the American Railway Association. Mr. Aishton's address was followed by the address of Chairman Smart. Abstracts of these and other addresses delivered at later sessions, and of the committee reports, with the accompanying discussions, follow:

Report of General Committee

Since the last annual meeting, the General Committee has held meetings on the following dates: June 27, 1928; October 3, 1928; March 20, 1929, and May 28, 1929.

The membership of the division at the present time includes 201 railways, representing 398 memberships in the American Railway Association, and in addition thereto, 356 railroads, associate members of the American Railway Association.

These railroads, members and associate members of the

American Railway Association have appointed 1,225 representatives in the Mechanical Division.

In addition there are 977 affiliated members and 206 life members in the division.

The last session of the division was held June 20-27, 1928, inclusive. Since that time, the General Committee has taken action on several important subjects. This action is outlined in the following report, and your approval is respectfully requested.

The provision of interchange Rule 66 making car owner responsible for the cost of a periodical repacking of journal boxes approved in the report of the Arbitration Committee at the 1926 annual meeting has been considered by your committee and the effective date extended from time to time. These extensions have been made to enable car owners to complete attention to their own equipment and also to enable action to be taken with respect to compliance with the present standard for packing of journal boxes, as recommended by the Committee on Lubrication of Cars and Locomotives, and adopted by letter ballot of the members.

This provision of the interchange rules will become effective January 1, 1930, and it is felt that no further extensions should be necessary.

The tank car specifications containing revisions approved by letter ballot in 1926 have not been reissued for the reason that the Interstate Commerce Commission is issuing specifications covering the tanks of such cars used for transporting dangerous commodities. It was felt advisable to wait until the Interstate Commerce Commission's specifications were issued before issuing the American Railway Association specifications, so there would be no conflict. The Committee on Tank Cars is now co-operating with the Bureau of Service, Interstate Commerce Commission, the Bureau of Explosives, the American Petroleum Institute and the tank car builders in revising these specifications and expects to be able to issue a revision of the American Railway Association specifications this year.

The investigation of power brakes and power brake systems has been continued throughout the year, and the director of research in charge of this investigation will present a report of progress at this meeting.

Draft Gear Tests at Purdue

The test of draft gears at the draft gear testing laboratory of the association at Purdue University which was started July 1, 1927, has been completed. The Committee on Couplers and Draft Gears, in its report this year, has included the complete report of these tests.

Arrangements have been made to continue the cooperation of the Committee on Tank Cars with the American Petroleum Institute and the American Railway Car Institute in conducting tests and investigations of tank-car appliances and devices. The equipment for these tests has been given to the association by the Union Tank Car Company and is now located at Purdue University, Lafayette, Ind.

No further action has been taken relative to recommendation for the elimination of brake pipe angle cocks from passenger equipment cars. It is expected that further recommendation will be made during the coming year.

The sub-committee handling the subject of damage to tracks and bridges due to brine drippings from refrigerator cars has been cooperating throughout the year with the sub-committee from the engineering division and has made considerable progress.

The General Committee has arranged for cooperation with the American Society of Mechanical Engineers upon the following subjects: Standardization of wrought-iron and wrought-steel pipe and tubing, standardization of rolled threads for screw shells of electric sockets and lamp bases, standardization of screw threads, standardization of high-pressure malleable-iron brass-seat unions.

The General Committee has joined with the General Committee of the Engineering division in recommending that the American Railway Association participate in a national program of boiler feedwater research.

The attention of the members is directed to the recommendations which will be found in the reports of the Arbitration Committee and the Committee on Car Construction on the subject of freight-car trucks. These recommendations have the full concurrence of the General Committee and members are urgently requested to give consideration to a program for the gradual replacement of arch-bar trucks on existing cars with cast-steel side frames complying with the specifications of the association. The members are also urged to support the Arbitration Committee in its effort to promote safety and economy through the use of cast-steel truck side frames on new cars and rebuilt cars.

Life Members

The following have been made life members of the division during the year:

Joined	Name	Title and railroad
1909	Bawden, Wm.	Superintendent motive power and equipment, Terminal Railroad Association of St. Louis
1909	Black, W. G.	Mechanical assistant to president, Erie
1909	Burton, T. L.	Air brake engineer, New York Central
1909	Chenoweth, E. G.	General foreman, Chicago, Rock Island & Pacific
1909	Coleman, C.	(Retired) Winona, Minn.
1909	Combs, W. B.	(Retired) Macon, Ga.
1909	Davis, J. H.	Electrical engineer, Baltimore & Ohio
1909	Depue, G. T.	Master mechanic, Erie
1909	Flynn, W. H.	General superintendent motive power and rolling stock, New York Central
1909	Greenwood, H. F.	Shop superintendent, Norfolk & Western
1909	Hoke, H. A.	Assistant mechanical engineer, Pennsylvania
1909	Jones, E. F.	Master mechanic, Belt Railway of Chicago
1909	Kinney, M. A.	Superintendent motive power, Hocking Valley
1909	Little, J. C.	(Retired) Chicago, Ill.
1909	Lynn, Samuel	Superintendent rolling stock, Pittsburgh & Lake Erie
1909	Machovec, E. E.	Mechanical superintendent, Atchison, Topeka & Santa Fe
1909	Miller, H. M.	Master mechanic, Susquehanna & New York
1909	Moore, B. R.	Superintendent motive power, Duluth & Iron Range
1909	Reid, H. G.	Assistant general superintendent motive power, Canadian National
1909	Ridgeway, H. W.	Superintendent motive power, Colorado & Southern
1909	Riegel, S. S.	Mechanical engineer, Delaware, Lackawanna & Western
1909	Rink, G. W.	Assistant superintendent motive power, Central Railroad of New Jersey
1909	Sternberg, A. S.	Master car builder, Belt Railway of Chicago
1909	Wagoner, J. F.	General foreman car department, Georgia, Florida & Alabama
1909	Weitzel, H.	Superintendent, Mexican Pacific

Obituaries

The secretary has been advised of the death of the following members during the year:

Name	Title and railroad	Died
Coe, T. W.	Superintendent motive power, New York, Chicago & St. Louis	May 18, 1929
Cory, Chas. H.	(Retired) Lima, Ohio	Nov. 3, 1928
Drury, M. J.	Mechanical inspector, Atchison, Topeka & Santa Fe	Jan. 29, 1929
Dyer, W. H.	Superintendent motive power, Georgia & Florida	Jan. 8, 1929
Grimes, L.	Master mechanic, Illinois Central	Feb. 23, 1929
Jacobs, H. W.	(Retired) Chicago, Ill.	....
Martin, J. H.	Superintendent car service, Berwind-White Coal Mining Co.	March 29, 1929
Thomson, Geo. D.	District master car builder, New York Central	Feb. 4, 1929
Turner, L. H.	Special representative of vice-president, Pittsburgh & Lake Erie	Feb. 23, 1929

The report is signed by G. E. Smart (chairman), chief of car equipment, Canadian National; A. R. Ayers (vice chairman), general manager, New York Chicago & St. Louis; C. E. Chambers, superintendent motive power and equipment, Central Railroad Company of New Jersey; C. J. Bodemer, superintendent machinery, Louisville & Nashville; E. B. Hall, superintendent motive power and machinery, Chicago & North Western; J. E. O'Brien, chief motive power and equipment, Seaboard Air Line; John Purcell, assistant to vice-president Atchison, Topeka & Santa Fe; J. S. Lentz, consulting master car builder, Lehigh Valley; J. A. Power, superintendent motive power and machinery, Southern Pacific Lines in Texas & Louisiana; O. S. Jackson, general superintendent motive power and machinery, Union Pacific; F. H. Hardin, assistant to president, New York Central; S. Zwight, general mechanical superintendent, Northern Pacific; A. G. Trumbull, chief mechanical engineer, Erie; R. L. Kleine, assistant chief motive power, Pennsylvania; W. L. Bean, mechanical manager, New York, New Haven & Hartford, and O. A. Garber, chief mechanical officer, Missouri Pacific.

Report on Nominations

The terms of office of the chairman and vice-chairman do not expire until June, 1930; therefore no nominations for officers of the division are made this year.

The terms of seven members of the General Committee ex-

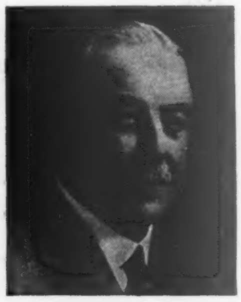
pire in June, 1929, and your Committee on Nominations nominates the following to serve until June, 1931, as members of the General Committee:

F. H. Hardin, assistant to president, New York Central
O. S. Jackson, general superintendent motive power and machinery, Union Pacific
J. S. Lentz, consulting master car builder, Lehigh Valley
J. A. Power, superintendent motive power and equipment, Southern Pacific Lines in Texas and Louisiana
A. G. Trumbull, chief mechanical engineer, Erie
S. Zwight, general mechanical superintendent, Northern Pacific
W. L. Bean, mechanical manager, New York, New Haven and Hartford

The report was signed by F. W. Brazier (chairman), assistant to general superintendent motive power and rolling stock, New York Central; T. W. Demarest, general superintendent motive power, Western Region, Pennsylvania; G. E. Chambers, superintendent motive power and equipment, Central Railroad of New Jersey; J. J. Hennessey, assistant master car builder, Chicago, Milwaukee, St. Paul & Pacific, and J. Purcell, assistant to vice-president, Atchison, Topeka & Santa Fe.

On motion the report was accepted and the nominees declared elected without balloting.

R. H. Aishton's Address



R. H. Aishton

To many of you the territory west of the Missouri river has been associated with deserts and Indians, and if from no other than an educational standpoint, it is a wonderful trip to see what we (I say we because I have spent most of my life west of the Missouri river) have out here.

There is not another place you can go to in the United States, where you will find more kindliness and neighborliness, or a greater measure of hospitality to a stranger than you will find here on the California coast. I know you will have a good time. If there is a doubt about that, I saw Gil. Ryder and Doc. Bateman at San Francisco, and they said that, if they could get away from the ball last night in time, they would be with you this evening, and in addition to giving you some pointers on purchasing properly, they will see that you are happy here.

I want to pay a tribute to what the Mechanical Division has done toward providing better and more efficient and economical transportation, in the last six years in particular.

You all know something about the conditions that prevailed in the period before the war, during the war and after the war—the period we are all trying to forget, when the service was notoriously inefficient, and the railroads were in a situation where they could not render service, and every man's hand was against us. You also know what happened when the railroads determined upon the measures that were necessary to bring about a better condition, and you know that since that time the railroads have spent about six billions of dollars for better locomotives, better cars, double tracks and signals.. Practically every dollar of this has been spent on those things which tend toward efficiency and economy and better service.

The Mechanical Division has been second to no division in the American Railway Association in its effort to carry out what was the determined policy of the railroads—to give the public of the United States the very best railroad service which it was possible to give it.

But don't let the feeling of satisfaction with yourselves and your performances put the brakes on anything that tends toward a forward movement. If you have met the situation today, that is not enough. In this great country of ours, we are getting new visions all the time. It is easy to understand why. About two and a half million children are born in this country every year, and their views and aspirations are different entirely from yours and mine today. Your job, and my job, and the job of the Association, and of all the executives of these railroads, is not for today but to get ready for five years from now or ten years from now. There is a constant development in the United States, not only in resources, but in the American mind, with respect to what it wants, and what is to be furnished in the way of transportation.

One of the great practical problems of the railroads today is competition; competition in the forms of transportation that were practically unknown ten years ago. You have the bus, the motor truck and the private passenger automobile on the highway. You have the airways. A line just starting within a few days will shorten the time from New York to Los Angeles some 48 hours, I believe it is, in combination with rail. We have a great inland waterway development program. The railroads are not opposing any one of these forms of transportation. On the other hand, in order that transportation to the public may be better, the railroads are adapting to their own use the automobile, the truck, the bus, and the airplane.

But with all that, when you consider the enormous traffic handled in this country—fifty-two million cars of revenue freight handled by the railroads last year, one million cars a week—the effect of these facilities on that volume indicates that the railroads will continue to be the backbone of transportation. Until something better is developed in the way of motive power than the steam locomotive, it has to do the job.

People are not going any slower in this country; they are going faster, and to meet the demand for speed, speed, more speed, and efficiency, efficiency, greater efficiency, that is the job before you.

You have been doing wonderful work and I hope you will keep it up. As distinguished a person as the President of the United States, Herbert Hoover, when he was Secretary of Commerce, made the statement that of all industrial developments in the United States, the development made by the railroads in the last few years was the outstanding feature. Now you have to keep that up. The public doesn't know much about what you are doing. An enormous thing—just for the purpose of determining whether the power brakes that are to be used on your trains are the best that can possibly be devised—is the power brake test conducted by the Mechanical Division. We just closed a contract with the Southern Pacific in the Siskiyou Mountains for the leasing of 35 or 40 miles of track, and Mr. Johnson is arranging for a test that will run over several months We have spent a million dollars in laboratory tests and we expect to spend much more before we get through, but in the end we will have the answer about power brakes. This country is way ahead of any country in the world on that subject, but with that we are not satisfied. That spirit ought to govern us in every activity that comes within our purview—research, constantly striving for something better.

I read a report by the Interstate Commerce Commission on the way out here, that pleased me very much.

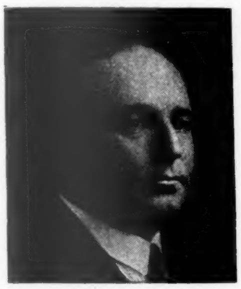
It was the report of the first three months of 1929, and I was very much surprised to note a little star in front of each item. I found a little footnote saying that it indicated that it was the best record ever made by the American railroads for the three-months period. That applied to every item in operation except one. That one was the carload.

You have increased the capacity of equipment in this country to a large extent; you have made longer trains possible and have done everything to produce economy, and yet in the matter of loading cars we are far behind. There is a reason for it. There is more fruit from California, and more vegetables from Florida; they all have light loading. There is no avenue that I know of from my experience, out of which you can get as many net dollars for the railroad without a dollar of additional expense, as bringing about heavy freight car loading.

I talked to the purchasing and stores officers yesterday. They are the biggest receivers of freight in this country. They agreed to try to bring about heavier loading. Now, if there is any of that which comes within the control of the mechanical people, you cannot do a greater service for the railroads than by conserving the equipment and loading it as heavily as you possibly can.

I would be lacking in appreciation if I did not express my appreciation and the appreciation of the railway executives of the country, for the care that Chairman Smart and the chairmen of all the committees have given to the affairs of the railways. I know of committees of this Division that have spent one-third of their time, not on the business of their own railroads, but on the general affairs of the railroads at Washington, to stave off a lot of those things that people are trying to wish off on us. I want this Division to know that while we don't have any bouquets or pat anybody on the back, there is a very deep appreciation for this on the part of the board of directors of the American Railway Association.

Address of Chairman Smart



G. E. Smart

I am well pleased to see such a large attendance here this morning, and I think it would be appropriate on this occasion for me to express the appreciation of all our members for the wonderful arrangements that the western railways have made in transporting our members to this city. Everything possible was done to make our trip out here an enjoyable one, and I don't know of any crowd of people that got acquainted so quickly and became one happy family. It was a fine example of that western spirit that we heard about from the representative of the Mayor.

The trip was a revelation to many of us of the wonders of this western country. We have representatives here from the extreme east, north and south, and we have a new appreciation of what transportation has done for this country.

Mr. Aishton has placed squarely before us mechanical officers just what we have got to do. We must not lay back on our past laurels. We have got to build locomotives bigger and better. We are getting them now so that we don't have to take them to the enginehouse every 125 miles. They are now running 800 miles and more. That is a good showing, but we must not be satisfied with it. We must still continue to do something better.

The railroads today are improving locomotives, increasing steam pressures, etc., and it is up to us as individual mechanical department officers to make every possible effort for still further improvements. Cars have been increased in capacity. Coming out here we saw the fields of grain. Just a few years ago, one car carried only 1,000 bushels of grain, 60,000 lb. in weight, and today we are handling 2,000 bushels. I don't know whether we can make cars much larger. We may have to remove some of the clearance limits before we can do so.

Mr. Aishton brought out a very important point in asking if we are loading equipment to capacity. The Committee on Loading Rules gives the best of advice to shippers regarding how commodities should be loaded, but suitable steps should be inaugurated to secure a generally heavier loading of practically all classes of freight equipment.

We have quite a heavy program. The committees have done wonderful work this last year. I am not going to call attention to each one of the committees. It is for you to judge for yourselves as their papers are put before you. We want to have a full discussion. As Mr. Aishton has said, these committees have in some cases spent 35 percent of their time, or more, getting out the reports which are presented here for your discussion. Let us have all questions thrashed out on the floor of this meeting so that when we go back home to our individual railways we will know that we have done our best for them and for the American Railway Association.

Four veterans, members of the Mechanical Division of the A.R.A. Seated, left to right: John Lentz, L. V.; J. J. Hennessy, C. M. St. P. & P., and F. W. Brazier, N. Y. C. Standing is V. R. Hawthorne, secretary of the A. R. A.

Report On Couplers and Draft Gears

R. L. Kleine
Chairman

Cases have been reported of train partings, due to the anti-creep device in the Type D coupler when fitted for bottom operation not being effective.

Investigation has developed that under certain conditions the present toggle does not engage the anti-creep ledge with the result that, there being nothing to prevent the lock from working up, opening of the coupler takes place.

For the purpose of making positive the anti-creep feature of the Type D coupler when fitted for bottom operation, a modified design of toggle, as illustrated, has been developed and recommended for adoption as standard by the Mechanical Committee of the Coupler Manufacturers' Association.

This modified toggle is applicable to both new and existing couplers and in an extensive service trial has been found to be entirely satisfactory as a means of preventing the lock from creeping up and causing uncoupling. The change in design is principally the extension of the locking face of the toggle, which is also located in a somewhat lower position than the present standard and at a slight angle so as to be parallel with the anti-creep ledge at time of contact. The length of the anti-creep ledge would be reduced 1/16 in., and suitable tolerance gages for the toggle and anti-creep ledge would be provided.

It is recommended that the modified design of toggle for bottom operated Type D couplers be adopted as standard in place of the present toggle.

Coupler Shanks Having Swivel or Radial Butts

Considerable interest is being shown by member roads in couplers having the standard Type D head and a shank with swivel or radial butt. Many such couplers have been applied experimentally and their performance is being closely followed by your committee.

Two questions have been raised in connection with the application of couplers of these types: First, as to whether they may properly be applied in view of interchange Rule 3 (c) (1); and second, as to protection for the owner for couplers or parts removed on foreign roads and replaced by standard Type D couplers or parts.

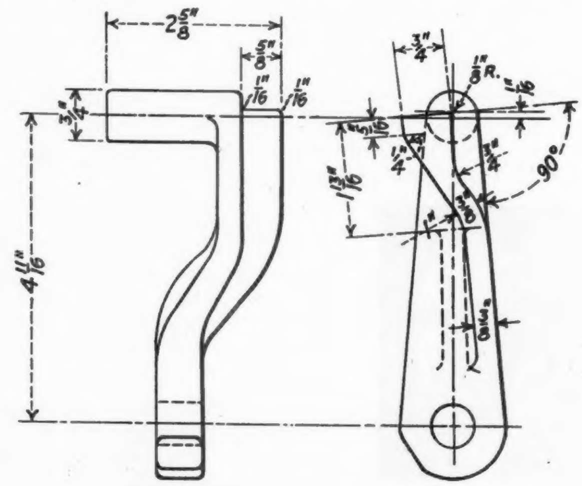
It is felt that a note or rule should be included in the interchange rules permitting the use of couplers having standard Type D heads and swivel- or radial-butt shanks, and their application to new and rebuilt cars, and that the interchange rules also provide that good parts, other than knuckles, locks, throwers, lifters and knuckle pivot pins, removed from any such swivel or radial butt couplers that have failed, may be returned to the car owner, if he so elects, with freight charges collect, and that provision be made for showing on the repair card the type of swivel- or radial-butt coupler removed.

The above recommendations have been submitted to the Arbitration Committee.

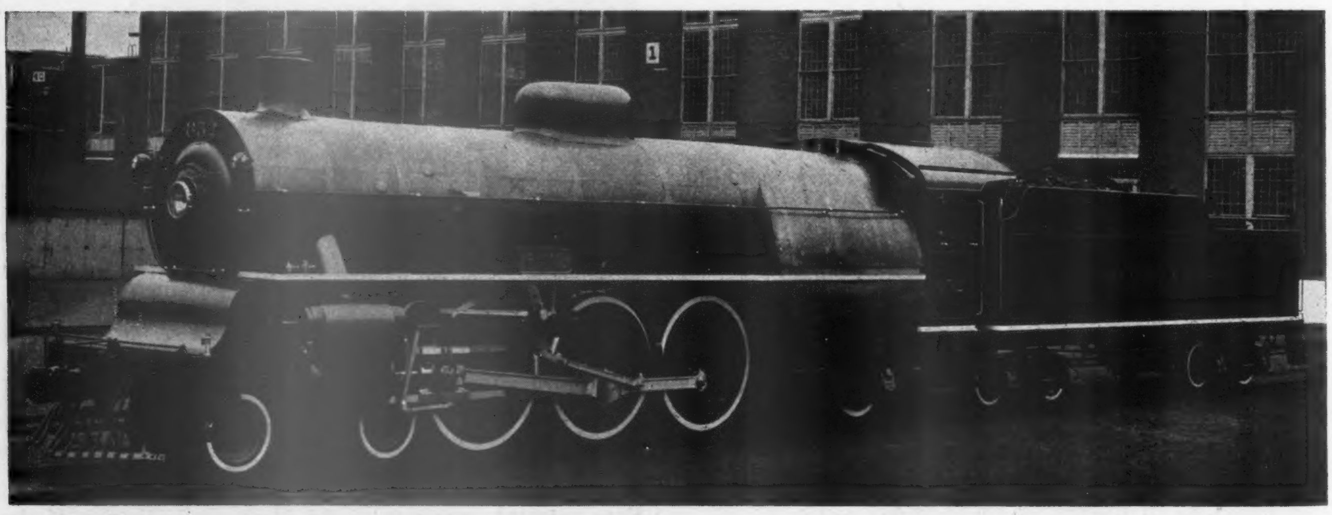
Rotary Operating Type D Coupler

A rotary operating mechanism for the Type D coupler has been brought out and a considerable number of these couplers are in service and on order. This form of operation possesses the advantage over the standard top and bottom types of operation of requiring much less effort to throw the knuckle.

Couplers of this design on equipment belonging to roads represented on your Committee are being followed up, and while thus far their performance has proved to be satisfactory



Modified coupler toggle recommended by the manufacturers



Delaware & Hudson 4-6-2 type locomotive which was built in the Colonie, N. Y., shops of the railroad and recently placed in passenger service

Maximum rated tractive force, 41,600 lb.—Diameter of drivers, 73 in.—Cylinders, diameter and stroke, 22 in. by 28 in.—Weight on drivers, 185,300 lb.—Total weight of engine, 283,300 lb.

in service, the arrangement is still looked on as experimental. The use of these couplers should be authorized not only for repairs, but for new and rebuilt cars and a suitable note or rule permitting their application included in the interchange rules. This recommendation has been submitted to the Arbitration Committee.

No recommendations are made at this time in regard to adopting the design as a standard of the association pending developments in the patent situation.

Failure of Type D Couplers in Service

Your committee and the Mechanical Committee of the Coupler Manufacturers' Association are in constant communication covering subjects pertaining to coupler design and performance, as the result of which a number of matters affecting coupler design are under consideration.

Reports have been received from time to time of the breakage of locks, failure generally occurring through the area of smallest section just below the lock-set shoulder, also head failures due to breakage of the side wall of the knuckle-tail cavity.

Examination of a considerable number of locks some of them broken and others only cracked, indicates that these lock failures are the result of fatigue and that conditions can be improved by the addition of metal in the location where breakage is taking place. While figures available do not indicate that a very great number of locks are failing in this manner, arrangements will be made to strengthen the design as soon as it is determined how much metal can be added without risk of interfering with operation or interchangeability.

The chairman of the Mechanical Committee of the Coupler Manufacturers' Association in reply to a letter on the subject of failures in this location has written your chairman in part:

I should like to call attention that there have been some changes made having this thought in mind. The first of these consisted of increasing the thickness of the knuckle side wall and removing a rib that apparently developed a strain. This change went into effect some time during the year 1918, perhaps about August 1. This change seemed to show a marked improvement, but with the idea of further improvement a still further reinforcement of the knuckle side wall was recommended in October, 1925, approved in November, 1925, and in view of the fact that this change involved also a change in the radius at the back of the knuckle tail, it is probable that these improvements were not fully carried out among all the manufacturers until late 1926 or possibly early 1927.

It is believed that the changes already made have materially increased the strength of the coupler in this location.

Draft Gear Tests

In our report submitted to the 1928 convention, the members were advised as to the progress of the A. R. A. draft-gear tests being conducted at Purdue University. The tests as originally arranged for have been completed and there are embodied in this report the results of the tests together with proposed tentative specifications for freight-car draft gears. The object of these tests was to develop on a uniform and comparable basis information as to the laboratory performance of draft gears on the market, from which specifications could be prepared, and if approved, followed by the railroads when purchasing draft gears for freight service.

It was not the intention that the draft gears tested would be graded or rated, or that opinions would be expressed as to the relative merits of the different designs or types.

In the report, which is very completely indexed, will be found the complete test results so arranged as to facilitate comparisons being made of the characteristics of the gears, including capacity, recoil, sturdiness, endurance, smoothness of action, and cushioning value, as developed in the drop-test machine experiments.

The following types of draft gears are included in the tests:

Table I—Average of Official Capacity Test with 27,000-lb. Tup-Chronograph Card Data

Make and type of gear	Card	Free fall (inches)	Closure (inches)	Total fall (inches)	Recoil (inches)	Net fall (inches)	Energy input (ft.-lb.)	Energy absorbed (ft.-lb.)	Absorption (percent)	Time (seconds): Compression	Time (seconds): Release	Time (seconds): Cycle	Velocity of impact of Tup (miles per hour)	Force-closure Diagram: Percent of energy input accounted for	Force-closure Diagram: Starting force (pounds)	Force-closure Diagram: Maximum force (pounds)	Velocity of car having 4 times energy input (miles per hour)
Bradford F-5-B	¼ cap.	0.75	1.40	2.15	0.05	2.10	4,830	4,720	97.7	.0768	.0238	.1006	1.36	99.65	10,730	123,630	1.85
	½ cap.	2.24	1.93	4.17	0.14	4.03	9,360	9,040	96.6	.0585	.0374	.0959	2.35	100.34	10,600	197,280	2.76
	¾ cap.	3.76	2.24	6.00	0.27	5.73	13,850	12,860	95.7	.0538	.0554	.1092	3.05	99.99	13,730	265,450	3.59
	Record blow	5.21	2.52	7.73	0.54	7.19	17,350	16,140	93.1	.0520	.0868	.1388	3.51	99.88	10,270	340,600	3.76
National M-17	¼ cap.	1.72	1.54	3.26	0.19	3.07	7,320	6,890	94.0	.0552	.0426	.0978	2.06	99.78	18,550	162,650	2.44
	½ cap.	4.19	1.98	6.17	0.47	5.70	13,840	12,790	92.4	.0463	.0701	.1164	3.22	99.92	26,300	293,200	3.36
	¾ cap.	6.92	2.45	9.34	0.67	8.67	20,953	19,450	92.8	.0449	.0791	.1240	4.14	100.57	28,420	348,530	4.13
	Record blow	9.66	2.76	12.42	0.83	11.59	27,890	26,020	93.3	.0449	.0893	.1342	4.89	99.48	34,780	404,350	4.77
Hall K-10-A	¼ cap.	1.36	1.22	2.58	0.14	2.44	5,780	5,470	94.6	.0438	.0350	.0788	1.84	99.57	15,320	275,970	2.17
	½ cap.	3.31	1.78	5.09	0.22	4.87	11,420	10,920	95.6	.0452	.0434	.0886	2.86	100.36	19,790	275,970	3.05
	¾ cap.	5.47	2.29	7.76	0.31	7.45	17,410	16,720	96.1	.0476	.0499	.0975	3.68	99.36	31,670	302,920	3.77
	Record blow	7.42	2.64	10.06	0.47	9.59	22,600	21,530	95.3	.0481	.0610	.1091	4.29	99.91	21,780	394,150	4.29
Westinghouse N-11-A	¼ cap.	0.75	1.33	2.08	0.06	2.02	4,660	4,540	97.3	.0652	.0261	.0913	1.34	99.99	4,800	121,500	1.95
	½ cap.	2.50	1.86	4.36	0.14	4.22	9,790	9,470	96.9	.0633	.0652	.1017	2.46	99.62	8,300	165,400	2.82
	¾ cap.	4.33	2.39	6.72	0.23	6.49	15,080	14,560	96.8	.0635	.0494	.1129	3.25	99.48	11,700	189,600	3.50
	Record blow	5.70	2.70	8.40	0.29	8.11	18,860	18,210	96.8	.0619	.0602	.1221	3.74	100.62	16,600	205,500	3.92
Sessions-Standard L	¼ cap.	1.48	1.04	2.52	0.16	2.36	5,660	5,300	93.60	.0426	.0389	.0815	1.91	99.30	38,180	244,230	2.15
	½ cap.	3.38	1.66	5.04	0.36	4.68	11,310	10,500	92.80	.0477	.0656	.1133	2.89	99.17	52,600	295,780	3.23
	¾ cap.	5.34	2.19	7.53	0.83	6.70	16,900	15,040	89.00	.0486	.1217	.1703	3.64	99.19	50,380	436,500	3.71
	Record blow	7.12	2.60	9.72	1.30	8.42	21,810	18,900	86.70	.0493	.1525	.2018	4.20	99.33	67,450	381,000	4.22
Miner A-79-X	¼ cap.	1.06	0.80	1.86	0.14	1.72	4,180	3,860	92.2	.0386	.0384	.0770	1.62	99.90	28,090	178,370	1.85
	½ cap.	2.33	1.40	3.73	0.26	3.47	8,380	7,800	93.1	.0484	.0637	.1121	2.42	100.03	31,160	203,340	2.61
	¾ cap.	3.82	1.91	5.73	0.52	5.21	12,860	11,700	91.0	.0532	.1104	.1636	3.08	100.00	33,760	191,860	3.24
	Record blow	5.17	2.48	7.65	1.25	6.40	17,160	14,360	83.7	.0573	.1618	.2191	3.58	99.77	35,890	286,890	3.74
Cardwell G-27-AA-Special	¼ cap.	1.00	0.87	1.87	0.06	1.81	4,260	4,060	96.3	.0497	.0242	.0739	1.57	100.05	55,040	119,000	1.85
	½ cap.	2.16	1.49	3.65	0.10	3.55	8,190	7,970	97.3	.0577	.0304	.0881	2.31	98.92	60,050	152,540	2.58
	¾ cap.	3.51	2.11	5.62	0.15	5.47	12,610	12,270	97.3	.0625	.0361	.0986	2.95	99.68	59,340	216,810	3.21
	Record blow	4.82	2.61	7.43	0.24	7.19	16,680	16,140	96.8	.0649	.0441	.1090	3.45	99.50	85,760	232,940	3.68
Murray H-28	¼ cap.	0.19	1.14	1.33	0.04	1.29	2,980	2,890	97.0	.1097	.0271	.1368	0.69	99.79	16,400	77,810	1.56
	½ cap.	0.94	1.86	2.80	0.08	2.72	6,290	6,110	97.2	.0863	.0348	.1211	1.53	100.01	26,725	105,625	2.26
	¾ cap.	1.72	2.29	4.01	0.12	3.89	9,000	8,730	97.0	.0832	.0412	.1244	2.06	99.19	18,240	115,260	2.71
	Record blow	2.70	2.66	5.36	0.37	4.99	12,040	11,200	93.0	.0754	.0669	.1423	2.59	99.70	26,225	194,490	3.18
Waugh-Gould 400-A	¼ cap.	1.12	1.38	2.50	0.09	2.41	5,615	5,410	96.4	.0573	.0306	.0879	1.67	99.90	15,960	166,110	2.14
	½ cap.	3.19	1.91	5.10	0.20	4.90	11,450	11,000	96.0	.0510	.0444	.0954	2.81	99.86	25,760	228,110	3.05
	¾ cap.	5.32	2.36	7.68	0.36	7.32	17,230	16,420	95.3	.0528	.0648	.1176	3.63	99.47	28,010	324,640	3.75
	Record blow	7.42	2.74	10.16	0.68	9.48	22,800	21,260	93.3	.0497	.0864	.1361	4.29	99.88	25,850	418,450	4.31
Edgewater B-32-K	¼ cap.	1.55	1.55	3.10	1.08	2.02	6,960	4,530	65.0	.0564	.1235	.1799	1.96	100.34	16,990	146,060	2.38
	½ cap.	4.11	2.08	6.19	2.29	3.90	13,910	8,750	62.9	.0509	.1050	.1559	3.19	99.75	16,410	189,000	3.37
	¾ cap.	6.87	2.50	9.37	3.67	5.80	21,060	13,030	61.9	.0488	.0867	.1355	4.12	99.42	23,975	254,560	4.14
	Record blow	9.51	2.81	12.32	4.96	7.36	27,650	16,520	59.7	.0450	.0732	.1182	4.85	99.45	25,110	417,610	4.75

The Bradford Corporation—Type F-5-B.
Edgewater Steel Company—Class B-32-K.
Hall Draft Gear Corporation—Class K-10-A
Keyoke Railway Equipment Company—Murray Type H, Class 28.
W. H. Miner, Inc.—Class A-79-X.
National Malleable and Steel Castings Company—Type M-17.
Standard Coupler Company—Sessions-Standard Type L.
Union Draft Gear Company—Cardwell Type G, Class 27-AA, Special.
Waugh Equipment Company—Waugh-Gould Type 400-A.
Westinghouse Friction Draft Gear Company—Type N-11-A.

In each case the manufacturer was requested to submit full information covering all draft gears manufactured by him intended for use in the standard 24⅝-in. pocket, together with his recommendations as to which type should be selected for test as representative of his latest design for freight service.

When working up the method of conducting the tests as given in the section of the report headed "Method of Testing Draft Gears on the A. R. A. Drop Test Machine" on page 14, the draft-gear manufacturers were consulted and their many helpful recommendations and suggestions in all cases given careful consideration.

The tentative specifications for freight car draft gears, as submitted, cover a design test and are not intended for acceptance tests for each lot of draft gears purchased. Should these tentative specifications be adopted, it is proposed to arrange for conferences with the manufacturers of draft gears in order to obtain the benefit of their views in preparing specifications for acceptance tests and in developing the tentative specifications which are included in this report.

Your attention is directed to Section 4 (b) under the heading "Reaction" in the proposed specifications, which reads as follows:

(b) To these specifications will be added a maximum limit for gear reaction. At the present time the chronograph is felt to be the most reliable instrument for determining this, but owing to the degree of accuracy and skill required to obtain dependable results, it is not considered practicable for commercial testing.

Arrangements have already been made for further investigation and research in order to develop for inclusion in the specifications a maximum limit for draft gear reaction and a reliable means for determining the reaction that will be suitable for routine commercial testing.

The draft gear tests were conducted under the supervision of the Sub-Committee on Draft Gear Tests, the personnel of which was as follows: C. B. Young, general mechanical engineer, Chicago, Burlington and Quincy; H. W. Coddington, engineer of tests, Norfolk and Western; H. I. Garcelon, assistant engineer of tests, Baltimore & Ohio; H. W. Faus, engineer of tests, New York Central; W. C. A. Henry, engineer of motive power, Pennsylvania, chairman. The sub-committee was ably assisted by L. H. Schlatter, foreman, physical testing laboratory and R. N. Miller, assistant engineer, both of the Pennsylvania.

The actual testing was directly in charge of Dean A. A. Potter, of the School of Engineering, Purdue University and director of the Purdue Engineering Experiment Station, W. E. Gray, engineer of draft gear tests, and C. W. Messersmith, assistant engineer.

There was at all times the closest cooperation between the sub-committee and those in charge of the tests during the entire period from the preliminary arrangement to the completion of the tests and in connection with the preparation of the report and of the tentative specifications.

Draft gears representative of the product of practically all of the manufacturers whose draft gears are included in this test are on trial on roads represented on your committee and their performance is being followed up and data obtained with particular reference to ability of the gears to withstand service, and capacity and recoil, as affected by actual service conditions.

In so far as making road tests from a train-operating standpoint is concerned, the subject is under consideration by your committee and while such tests may be desirable at a later date, after the adoption of specifications and purchase of draft gears in accordance therewith, it is not felt that conditions at this time warrant the association arranging for road tests.

Under the terms of agreement with Purdue University, manufacturers of draft gears desiring tests or other research work on the A. R. A. draft-gear testing machine may have such work undertaken when the testing machine is not engaged on A. R. A. work, by making arrangements with the Purdue University authorities. The opportunity thus offered should be very helpful in the development of draft gears and it is hoped that full use will be made of it.

Your committee wishes to express its appreciation of the assistance of the manufacturers of draft gears in furnishing information and advice when called upon, and for their valuable suggestions in connection with determining upon the methods to be followed in making the tests.

It is believed that the tentative specifications for freight-car draft gears as submitted are reasonable in view of present day operating conditions, and that their adoption and observance will greatly improve the draft-gear situation.

It is recommended that they be adopted as a tentative standard of the association for freight-car draft gears.

(The committee inserted at this point an extensive detailed report of the draft gear tests comprising over 300 pages of text matter, tables and charts. This report contains a description of the test plant, methods of testing, computation of results, description of the 10 types of gears submitted for test and a complete record of capacity, sturdiness, recoil and endurance tests of each gear. An appendix to this report gives in detail the tentative specifications, also the approved method of determining reaction, one of the most difficult draft-gear characteristics to determine with accuracy.—Editor.)

Table II—Sturdiness Record of all Draft Gears Tested

Make and type of gear	Gear number	Initial cycle (in. free fall)	Number of cycles before failure occurred	Final cycle (in. free fall)	Reason for failure
Bradford F-5-B	2	8.25	3	9.25	Loss of normal functioning
	5	6	3	7	Bulging
	7	7.50	4	9	Bulging
	9[1]	5.75	11	8.25	Bulging
	10	6	7	9	Bulging
	Average	6.70	5.60	8.50	
National M-17	16	11	6	13.50	Shortening
	17	11.25	1	11.25	Short solid ht.
	19	10	9	14	Shortening
	21	11.25	6	13.75	Shortening
	22	8.25	13	14.25	Shortening
	Average	10.35	7	13.35	
Hall K-10-A	27	6	2	6.50	Sticking
	28	7.25	3	8.25	Shortening and sticking
	30	8.25	7	11.25	Shortening
	32	6.50	4	8	Loss of capacity
	33	3.25	6	5.75	Loss of capacity
	Average	6.25	4.4	7.95	
Westinghouse N-11-A	35[1]	6.75	6	8	Shortening
	37	6	3	7	Shortening
	39	6	2	6.50	Shortening
	41	7	2	7.50	Shortening
	43	5	9	9	Shortening
	Average	6.15	4.4	7.60	
Sessions-Standard L	46[1]	5.75	9	7.75	Sticking
	48	7.50	6	10	Shortening and sticking
	50	7.25	4	8.75	Bulging and sticking
	52	8.50	4	10	Bulging and sticking
	54	7.50	2	8	Bulging and sticking
	Average	7.30	5	8.90	
Miner A-79-X	68	5.25	9	9.25	Bulging
	70	5.50	15	12.50	Bulging
	72	5.25	9	9.25	Bulging
	74	4	9	8	Bulging
	76	5.75	10	10.25	Bulging
	Average	5.15	10.40	9.85	
Cardwell G-27-AA-Special	78	5	2	5.50	Bulging
	80	5.25	1	5.25	Bulging
	82	4.50	4	6	Bulging
	84	4.75	3	5.75	Bulging
	86	5.50	3	6.50	Bulging
	Average	5.00	2.60	5.80	
Murray H-28	88	2.50	4	4	Bulging and sticking
	90	3.75	3	4.75	Bulging and sticking
	92	2.75	5	4.75	Bulging, sticking and shortening
	94	2.75	4	4.25	Sticking
	96	3	2	3.50	Bulging and sticking
	Average	2.95	3.60	4.25	
Waugh-Gould 400-A	98	6.50	5	8.50	Shortening and loss of capacity
	100[2]	7.75	7	10.75	Shortening
	102	7.25	5	9.25	Loss of capacity
	104	7.50	5	9.50	Shortening and loss of capacity
	106	7.50	6	10.00	Shortening
	Average	7.30	5.60	9.60	
Edgewater B-32-K	108	9	9	13	Shortening
	110	9.75	7	12.75	Shortening
	112	9.75	8	13.25	Shortening
	114	10.00	6	12.50	Shortening
	116	9.50	10	14	Shortening
	Average	9.60	8	13.10	

[1] ¼-in. increment method.
[2] Received two irregular over-solid blows.

Tentative Specifications for Freight Car Draft Gears

Draft gears, to be acceptable for freight service, should meet the following specifications, and the purchaser or his representative should make such tests as may be necessary to satisfy himself that the gears meet the requirements of these specifications.

Dimensions and Marking

1. (a) The outside measurements of the gear shall be such that with the necessary followers, it may be applied in the A. R. A. draft-gear pocket, 9⅛ in. by 12⅞ in. by 24⅝ in.

(b) The travel of the gear shall be not less than 2½ in. nor more than 2¾ in.

(c) The solid height of the gear with its necessary followers must not be less than 21⅞ in. This solid height shall be determined under the drop-test machine, using a method similar to that specified in Par. 2 (g).

(d) In a suitable location not subject to wear, the month and year of manufacture shall be cast on draft gear casings that are cast, or stamped on casings that are forged.

Test Set-up and Definitions

2. (a) Six gears shall be subjected to the tests hereinafter specified.

(b) In order to eliminate the effects of atmospheric conditions as much as possible the testing laboratory should be in a building having a uniform temperature and the gears should stand in this laboratory at least 24 hrs. before being tested. The friction surfaces shall be protected from moisture, grease, dust, etc.

(c) All tests shall be made with a suitable drop-test machine equipped with either a 27,000-lb. or a 9,000-lb. freely falling tup. The anvil of this machine should be supported on a foundation of the greatest possible rigidity and the gears shall be placed in pockets which rest upon the solid anvil and are designed to hold the gear to normal length, the regular complement of followers being used as in service.

Fig. A shows the pocket and test set-up which is recommended. The followers shall be the A. R. A. standard rough-forged followers, 8½ in. by 12½ in., except that they shall be machined on one side only to give a uniform thickness of 2¼ in., plus or minus 1/64 in. The unfinished surface shall be placed next to the gear in testing. The friction elements

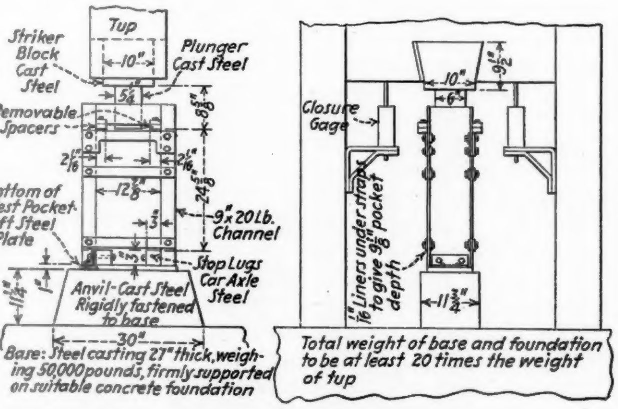


Fig. A—Recommended draft-gear pocket and test set-up with either 9,000- or 27,000-lb. tup

of the gear shall be turned up or down according to the recommendation of the manufacturer.

(d) In order to prevent objectionable heating of the friction surfaces, no gear shall be subjected to more than 100,000 ft.-lb. of work in any half hour.

(e) The datum line for determining free fall of the tup and closure of the gear shall be established by lowering the tup until the plunger in the test pocket is barely loose.

(f) The closing height of a gear is the free fall of the tup which just closes the gear.

(g) The capacity of a gear is the weight of the tup in pounds multiplied by the total fall in feet which closes the assembly of gear and followers to a length of 21⅞ in., or to the solid point of the gear should this be greater than 21⅞ in. This length will be computed by subtracting height of plunger, thickness of bottom of test pocket, and gear travel from the height of the tup above the anvil when in datum position.

(h) The recoil of a gear is the height above the point of maximum closure which the tup reaches on the first rebound, expressed as a percentage of the total fall of the tup. When measuring recoil close to the solid point of a gear caution should be used, as the effect of the gear going slightly oversolid is very great.

Capacity Test

3. (a) The capacity of the six representative gears shall be determined by a closure test made as follows: If a 27,000-lb. tup is used, start at 1 in. free fall, continue with 1 in. increments until the closure is within ½ in. of nominal total closure, use ½ in. increments until the closure is within ¼ in. of nominal total closure, and then use ¼ in. increments until the gear is solid. If a 9,000-lb. tup is used, start at 3 in. free fall, use 3 in. increments until closure is within ½ in. of nominal total closure, use 1 in. increments until closure is within ¼ in. of nominal total closure, and then use ½ in. increments until the gear is solid. The solid point shall be determined by the use of lead records if possible; otherwise by nail penetration in a wood block, or equivalent method.

(b) In determining the solid point, small pieces of 1/16-in. sheet lead not exceeding ½ in. in width, or lead wire ⅛ in. in diameter shall be inserted at four points approximately equidistant, when the construction of the gear will permit. A gear will be considered as solid when any two lead records are sheared or flattened to a thickness of 0.01 in., unless it has been determined that some other part of the gear goes solid before this point is reached. In this latter case the solid point will be considered to be where the parts first went solid. If any coil springs go solid when or before the gear goes solid, the gear will not be acceptable.

(c) In order to pass this test satisfactorily a gear must have a minimum capacity of 18,000 ft.-lb. The capacity at half travel should not be less than 25 per cent, and shall not be less than 20 per cent, of the capacity at full travel.

(d) If the capacity of not more than two of the six gears is less than 10 per cent under the prescribed minimum of 18,000 ft.-lb., there may be substituted in their places alternate gears which shall also be given the capacity test.

(e) The gears shall be considered as having satisfactory capacity if:

1. All gears meet the requirements.
2. At least four of the first six gears tested meet the requirements, the other gears do not fall more than 10 per cent below the requirements, and the alternate gears tested meet the requirements.

If these conditions are not met, the gears will be considered as not having satisfactory capacity.

(f) The gears passing the capacity test shall be subjected to further tests as hereinafter specified.

Reaction

4. (a) While a high maximum capacity is desirable, yet it should not be secured by too high gear reaction. Any gear which shows more than 27,000 ft.-lb. capacity should be viewed with suspicion until it is established that its reaction is not undesirably high.

(b) To these specifications will be added a maximum limit for gear reaction. At the present time the chronograph is felt to be the most reliable instrument for determining this, but owing to the degree of accuracy and skill required to obtain dependable results, it is not considered practicable for commercial testing.

Recoil

5. The recoil shall be measured while making the capacity test. A minimum recoil, consistent with freedom from sticking, is desirable. The gears will be considered as having satisfactory recoil if the average for the six gears on the last blow before each one goes solid does not exceed 20 per cent with a 27,000-lb. tup or 25 per cent with a 9,000-lb. tup.

Sturdiness Test

6. (a) The three gears having capacity nearest to 18,000 ft.-lb. shall be subjected to the sturdiness test.

(b) Each gear shall be given a cycle of five blows at a free fall of 5½ in. if a 27,000-lb. tup is used, or at 22 in. if a 9,000-lb. tup is used.

(c) The test will be continued in cycles of five blows, the height of free fall of the tup for each cycle being increased over that for the preceding cycle by ½ in. if a 27,000-lb. tup is used, or by 1½ in. if a 9,000-lb. tup is used. A gear shall not be given more than 100,000 ft.-lb. of work in any half hour.

(d) The test shall end when twelve cycles, or sixty blows, have been given to the gear, provided failure of the gear does not occur before this point is reached. This will result in the free fall of the last cycle being 11 in. with a 27,000-lb. tup, or 37½ in. with a 9,000-lb. tup.

(e) At the end of this test the gears will be calibrated as during the capacity test, paragraph 3 (a) and (b). They shall then be taken apart for inspection.

(f) A gear developing any of the following defects shall be considered as not having passed the test:

(1) Shortening, bending, crushing, or deforming an amount which makes the solid height of gear and followers ¼ in. less than the original solid height as given in paragraph 1 (c). The solid height shall be determined by subtracting the length of plunger block, thickness of bottom of test pocket, and gear closure from the height of the tup above the anvil when in datum position.

(2) Breakage of an essential part. Flaking or spalling of friction surfaces will not be considered as constituting such breakage unless it be of sufficient extent to interfere with the normal operation of the gear.

(3) Widening or spreading of any part or parts to cause binding in the standard pocket, 9⅛ in. or 12⅞ in.

(4) A reduction of capacity below 13,500 ft. lb.

Endurance Test

7. (a) The other three gears having passed the capacity test shall be subjected to the endurance test.

(b) This test will be made according to a cycle whereby the gears will receive a maximum number of blows from a low fall of the tup. The cycle will be as follows, when using a 27,000-lb. tup:

1 blow at 1 in. free fall.
1 blow at 1 in., and 1 at 1¼ in. free fall.
1 blow at 1 in., 1 at 1¼ in., and 1 at 1½ in. free fall, etc.

If a 9,000-lb. tup is used the heights of drop will be three times those specified above.

Proceed thus up to a free fall which closes the gear to within 0.10 in. of solid, as determined by the use of a lead record. When this point is reached the cycle shall be started over again.

(c) The test shall end when not less than 10 million ft.-lb. of energy, as determined by the free fall of the tup, has been delivered to each gear, provided failure does not occur before this point. In no case, however, will the test be ended before the last cycle of blows has been carried to the point where the gear closes to within 0.10 in. of solid.

(d) At the end of this test the gears will be calibrated as during the capacity test, paragraph 3 (a) and (b). They shall then be taken apart for inspection.

(e) A gear not developing any of the defects enumerated in Par. 6 (f) shall be considered as having passed the test, except that the capacity must not be less than 15,000 ft.-lb.

Sticking

8. Sticking is a very serious fault in a draft gear. There is no definite test for sticking, and the action of the gears throughout all of the other tests will determine whether they are acceptable from this standpoint. Any type of gear which regularly and persistently sticks will not be acceptable.

Uniformity of Action

9. (a) A well designed and manufactured draft gear should show reasonable consistency in its action with respect both to other gears of the same type and to its own action. The permissible amount of variation in capacity among gears of the same type is questionable, but if the capaci-

ties are held between limits of 27,000 and 18,000 ft.-lb. the gears will be acceptable on this basis.

(b) In regard to uniformity of action in the gear itself, the closure on any blow should increase if the height of drop is increased. Any gear which shows a smaller closure if the height of drop is increased should be regarded with suspicion. Neither should a gear show an abnormal increase in capacity after it is placed in service. A gear in the endurance test should not build up capacity in excess of 27,000 ft.-lb. unless the reaction is not undesirably high.

The report is signed by R. L. Kleine (chairman), assistant chief of motive power, Pennsylvania; C. P. Van Gundy, engineer of tests, Baltimore & Ohio; C. J. Scudder, superintendent motive power and equipment, Delaware, Lackawanna & Western; H. W. Coddington, engineer of tests, Norfolk & Western; C. B. Young, consulting mechanical engineer, Chicago, Burlington & Quincy; Samuel Lynn, superintendent rolling stock, Pittsburgh & Lake Erie; L. P. Michael, mechanical engineer, Chicago & North Western; E. A. Gilbert, general master car repairer, Southern Pacific, and M. A. Hall, superintendent machinery, Kansas City Southern.

Discussion

(That part of the report pertaining to couplers was read by Chairman Kleine. H. W. Faus, engineer of tests, New York Central, then presented a brief statement of the objects of the draft gear tests, also later reading the proposed specifications. W. E. Gray, engineer of draft gear tests, Purdue University, read the major part of the report and explained how the test data, charts and curves can best be interpreted and used.—Editor.)

R. L. Kleine (Penna.): The specifications submitted by your committee are based on a careful study and analysis of the draft gear situation to date. The drop tests have developed to a marked degree some of the failures found in service on individual gears. The draft gear manufacturers have cooperated 100 percent with your committee in the laying out of the tests, but they received no results of the performance of their gears in the laboratory tests until advance copies of this report were available.

It is the purpose of your committee, with your approval, to have joint conferences with the draft gear manufacturers during the ensuing year, to go over these tentative specifications with them with a view of strengthening the specifications, and to give all the members of our association the opportunity for constructive criticism. This will aid the committee in presenting to you, next year, specifications for adoption as recommended practice, which all new freight car draft gears shall meet.

During these tests manufacturers have made progress through changes in their draft gears, and it is the firm belief that by cooperation between the draft gear manufacturers and your committee, progress in draft gear design will be stimulated to the end that the specifications evolved will meet with your approval.

Because of the vital interest of the manufacturers in this matter, may I suggest that the privilege of the floor be extended to them during the discussion of this report?

Chairman Smart: If there are no objections, the privilege of the floor will now be extended to the manufacturers for any discussion.

William Wright (Edgewater Steel Company): The thing that we are interested in at the present time is the matter of creeping which was not tested at Purdue. The proposed specifications limit the recoil to 20 to 25 per cent, but there must be a comparatively high recoil in order to prevent creeping. We are interested in that phase of the specifications, because we wish to provide a full draft demonstration of the anti-creeping feature of our gear. The best way we can demonstrate the anti-creeping feature is by service tests.

G. Q. Lewis (W. H. Miner, Inc.): The committee is to be congratulated on the important work just completed at the draft gear testing laboratory at Purdue University. The report is concisely written and conclusively indicates that the tests have been conducted in a most efficient manner.

We are pleased to note that upon adoption of the tentative specifications the committee intends to confer with the manufacturers for the purpose of formulating acceptance tests and modifying said tentative specifications governing gear performance as may be necessary.

Table III—Endurance Record of all Draft Gears Tested

Make and type of gear	Gear number	Total energy input before failure occurred	Reason for failure	Total number endurance blows	Number blows stuck: Total	Number blows stuck: During last 100 blows
Bradford F-5-B	1 [1]	5,734,200	Breakage	616	152	0
	3 [2]	5,129,000	Loss or normal functioning	689	20	0
	4	9,349,900	Loss of capacity	1,720	1	0
	6	10,733,600	Loss of capacity	2,323	398	0
	8 [3]	13,840,100	Loss of capacity	2,934	71	1
	Avg.	8,957,360				
National M-17	13 [3]	69,172,900	Loss of capacity	10,412	0	0
	14	158,180,500	Loss of capacity	20,789	1	0
	15 [4]	48,521,600	Breakage	4,599	0	0
	18	165,552,000	Loss of capacity	16,999	2	0
	20 [5]	91,401,300	Breakage	9,021	0	0
	Avg.	106,565,660				
Hall K-10-A	24 [3]	1,894,700	Sticking	210	96	49
	25	8,741,100	Loss of capacity	1,366	111	0
	26	5,338,400	Sticking	718	181	56
	29	5,519,700	Sticking	708	215	37
	31	3,020,000	Sticking	344	286	89
	Avg.	4,902,780				
Westinghouse N-11-A	34 [3]	14,748,900	Loss of capacity	2,534	0	0
	36	16,797,500	Loss of capacity	2,824	0	0
	38	10,584,700	Loss of capacity	2,163	0	0
	40	12,900,500	Loss of capacity	2,651	1	0
	42	24,051,300	Loss of capacity	4,209	12	0
	Avg.	15,816,580				
Sessions-Standard L	45 [3]	2,234,400	Sticking	189	113	66
	47	3,108,700	Sticking	300	240	82
	49	3,373,900	Sticking	300	268	81
	51	858,400	Sticking	52	52	
	53	2,905,200	Sticking	300	255	98
	Avg.	2,496,120				
Miner A-79-X	67 [6]	87,951,100	Loss of capacity	9,071	18	0
	69	92,157,300	Loss of capacity	10,104	0	0
	71	100,303,400	Loss of capacity	12,526	4	0
	73 [7]	52,899,100	Bulging	3,749	0	0
	75	110,725,800	Loss of capacity	12,394	9	0
	Avg.	88,807,340				
Cardwell G-27-AA-Special	77 [8]	4,751,600	Sticking and bulging	743	345	99
	79 [9]	9,565,100	Sticking, bulging and breakage	1,600	173	99
	81 [10]	8,721,800	Sticking and breakage	1,461	199	100
	83 [11]	11,127,300	Sticking and bulging	1,886	636	100
	85	9,988,100	Sticking	1,789	21	15
	Avg.	8,830,780				
Murray H-28	87	1,078,600	Sticking	203	142	62
	89	288,400	Sticking	54	54	
	91	689,500	Sticking	168	140	100
	93	773,900	Sticking	196	195	100
	95	408,600	Sticking	52	52	
	Avg.	647,800				
Waugh-Gould 400-A	97	37,547,900	Loss of capacity	5,157	3	0
	99	54,079,600	Loss of capacity	7,081	5	0
	101 [12]	25,666,700	Breakage	2,798	2	0
	103	68,423,900	Loss of capacity	9,735	19	0
	105	40,442,900	Loss of capacity	5,679	106	0
	Avg.	45,232,200				
Edgewater B-32-K	107 [13]	159,198,400	Loss of capacity	20,338	0	0
	109 [6]	173,049,900	Loss of capacity	25,594	1	0
	111 [6]	108,435,700	Loss of capacity	16,095	24	0
	113 [6]	85,719,700	Loss of capacity	11,814	26	0
	115 [6]	148,526,600	Loss of capacity	21,887	0	0
	Avg.	134,986,100				

[1] Friction housing cracked.
[2] Lugs on stationary plates upset, causing abnormal gear action.
[3] Tested by 1-in. increment method.
[4] Friction segment support broken off friction segment seat.
[5] Follower wedge cracked.
[6] Release action sluggish during last part of test.
[7] Cylinder bulged 3/16 in. near bottom.
[8] Top casing bulged 15/64 in.
[9] Top casing bulged 3/32 in. and one triangular friction block broken.
[10] One triangular friction block and one side friction member broken.
[11] Top casing bulged 9/64 in.
[12] Housing split.
[13] Three main outer rings broken. Release action sluggish during last part of test.

We are carefully studying the report with this end in view and at the proper time will be glad to cooperate in every way possible.

The principal function of the draft gear is to accomodate maximum smash or jerk power in actual service with minimum gear reaction or sill pressure. The necessary protection of railroad equipment from the damaging effects of end shock must include a mechanism which will produce maximum performance per dollar of cost and ensure sustained efficiency throughout the car life. The committee therefore will no doubt do everything possible to adjust the specifications whereby laboratory practice will truly interpret actual requirements of service conditions.

The report particularly emphasizes the need for a quick and accurate method of determining gear reaction or sill pressure. We agree that the chronograph is the most reliable instrument at present for determining reaction and also that, owing to the degree of technical skill and accuracy necessary to secure dependable results, it is not an entirely practicable device for ordinary testing.

We have used the chronograph in connection with our development work for over 15 years and found this apparatus indispensable to the interpretation of draft gear performance. In view of the limitations of the chronograph we have spent considerable effort in developing a more direct method of sill pressure determination and are confident that we will shortly be able to demonstrate to the committee a thoroughly practical method of quickly and accurately determining gear reaction or sill pressure by direct indication.

In further discussion of the question of gear reaction, particularly as it relates to the shock protection of car construction and lading, we urgently recommend that the committee consider a method of draft gear testing whereby the blows of the hammer are delivered to any gear through a unit structure capable of being protected from collapse by the shock protection efficiency of the draft gear, and that the results be judged in terms of the amount of prevention against collapse rendered to said standard unit structure and the gear structure as well, all gears being subjected to an identical system of hammer loading.

Another suggested line of attack on the draft gear problem is presented by high speed photography. We have made much progress in this art during the past seven years and will welcome an opportunity to give the committee the benefit of our experience with this most important and interesting method of analysis, which makes it possible to obtain utmost precision in observing and defining draft gear action. Through this agency we have found it possible to improve greatly the design, metallurgical practice and method of manufacture whereby for nearly a year all of our gears have embodied a much higher degree of sustained shock protection efficiency than was incorporated in our gears which were used in the recent Purdue University tests.

Great and general interest has been inspired by the activities of the draft gear committee at the Purdue University laboratory, and the report of the committee will confer lasting benefit upon the railroads and will undoubtedly prove to be a great incentive to further progress.

L. M. Clark (Waugh Equipment Company): Mr. Gray and his associates at Purdue University are to be commended for the work that they have done on these test gears. The report is very complete in details of capacity, uniformity, recoil, endurance, sturdiness. I believe, however, that there is one important protection factor, which gears of different types have, and which the committee has to some extent disregarded. I am speaking now of the tests in which coupler shanks, or steel discs, or some other equivalent, are introduced between the tup and draft gear. I hope the committee next year will consider that sort of test in continuing the investigation of the subject, and I think it will prove of general value and interest.

T. W. Demarest (Penna.): The American Railway Association has met, through its life time, and overcome some major problems. They have had the air brake and the automatic coupler, the truck side frames, and the center sills. Now you have before you the question of draft gears, and I am not at all sure but that the ultimate solution of this problem will prove more difficult than any other.

In what I am going to say, I want to impress upon the members of this association that there is no difference of opinion between your draft gear committee and myself, except perhaps that my concept of the ultimate draft gear goes perhaps a trifle farther than is expressed in the proposed specifications.

To me, the seven requirements which the committee has presented are singularly silent on one of the important characteristics of any draft gear, and that is the delay in transmission of the blow to the car body structure. In the initial application of draft gears, we started with coil springs, and, due to the springs themselves there was practically no time element between the start of the blow and the final closure of the springs. The recoil action of the coil spring in effect is exactly the compressive action.

The friction draft gear was developed in part to do two things: First, to increase the capacity of the gear beyond the ability of the spring gear; Second, to absorb more shock than the spring gear could possibly absorb. That work of absorption is proportionate to the length of time of gear closure, also to the length of travel of the gear.

The question which I think is before this association is something greater than meeting any present situation. We have got to build not for tomorrow, or the day after, but for five and ten years ahead. I take it, and if I am mistaken the members of the draft gear committee will correct me, that there is not a draft gear on the market today. I say that with this reservation, that the present draft gear condition is more the responsibility of the railways than it is of the draft gear manufacturers.

The draft gear is in its present condition today, because we have not given the draft gear manufacturer the room to accommodate an adequate gear between the sills. In the first place we started with our old standard sill space. We told the manufacturer that he must build a draft gear to go in where the spring gear was before. We restricted him as to travel by limiting the length of the coupler pocket so that he was absolutely in a position of having to fit any device in a fixed space and not extend the size of his gear to meet increased demands. He did it partially in two ways. Some manufacturers constructed the gear case to act as a follower and obtained through that method perhaps 2 in increased length. Some other manufacturers took advantage of the space outside of the draft sills and placed their springs in between the draft sills and the intermediates and got more spring space that way. At no time during this development, however, have we gone to the manufacturer and said, "We recognize the limitations of any draft gear based on the space we have given you to work with. We are prepared to help you

in developing the ultimate gear by giving you more space to work in, either width as between sills or length as between the front follower and the rear stops."

You have not stopped yet with the demand on friction draft gears. Inevitably, as you increase the capacity of the gear and limit the travel to a fixed distance, you shorten up the time period between the application of the blow and the time it reaches the car structure and in effect develop a gear which more nearly resembles in its action the old time solid block. That is just the situation, I am sure, that you and the gear manufacturers themselves desire to get away from, and, if that process is continued, we are ultimately going to get to the place where it will be necessary to increase center sill sections again or else redesign the Type D. coupler.

Somebody may say that increased travel will only increase the free slack between cars, and we have too much of that already. Let's examine that statement a minute. With good car condition, we have an average of 9 in. of free slack, and that may run up to 12 in. or more in wear at knuckles, slack between stops and errors in the initial placing of stops. Slack may be due to bending or wear of followers, weak springs, or wear in the gear itself, so that the draft gear gets initial travel without absorbing the shock. It would be a good deal better to use that free slack in the travel of a proper and sufficient draft gear than wasting it as we are doing now.

My thought is simply this, we can't stop and we must not stop. We must look ahead and recognize the limitations on proper draft gear design brought about by present inadequate transverse dimensions and longitudinal travel. It is not hard for us to respace the centers. Perhaps you may say that, on existing equipment, it is impracticable, but why not work for the future? It took us years to get the Type D coupler, but now we have it. It will probably take us years to get the draft gear we are after, but we have the time and we can do it.

Professor L. E. Endsley (University of Pittsburgh): In 1915, I said that in 5 to 10 years freight equipment would have to be protected better than can be done in 2¾-in. of gear travel. I asked at that time that the draft gear manufacturers be requested to design gears with 4-in. or 4½-in. of travel. So I merely get on my feet this morning to say that my conviction has not been changed. When we protect 70-ton and 100-ton cars perfectly, we will not do it in 2¾-in. travel. Engineers here today will bear me out when I say that if you double the travel, you can get four times the protection with the same release of gear. So, gentlemen, when we do this right, we are going to develop larger draft gear travel, as Mr. Demarest has suggested.

I hope that in the next year the committee will give a little thought to providing more space for draft gears. We cannot make a car frame strong enough to withstand the shock with 2¾-in. travel gears. If two cars of equal strength come together we are bound to destroy one of them. We can't make two cars of exactly the same strength. All of our old equipment will go out fast if we simply strengthen the new equipment. Big capacity draft gears will protect our old equipment along with protecting the new equipment.

R. L. Kleine (Penna.): Your draft gear committee appreciates and invites the constructive criticisms that we have heard and especially the address of my colleague, Mr. Demarest. The draft gear development, I think, was retarded considerably by arguments in regard to travel, studying center sills in order to get increased width for draft gear and other details. The car construction committee years ago wrestled with the question of draft gear travel.

However, if increased travel of draft gears is the essential feature, the other features can no doubt be accommodated to the increased travel. Insofar as the slack is concerned, the draft gear travel is 2¾-in., and we have a total of 5½-in. on one car between compression and a completely pulled out coupler and 5½-in. on the other car, which gives a total of 11 in. Between the couplers themselves, there is a slack of anywhere from ⅞-in. to 2-in., but that is the only free slack that you have if the draft gear is in proper condition.

The requirements of the specification for sturdiness are going to cut down uncontrolled slack, and that is the serious thing we have to contend with. Professor Endsley said that he advocated 4½-in. travel in 1915. At that time I think he showed about a million pounds stress on the center sills with the draft gears in use at that time. If we had that, we would be in trouble all the time. I think the important function of the draft gear is the reaction; let the travel be what it may in order to obtain that reaction.

Your committee, on page 304 of the report, has specifically stated why a high maximum reaction is desirable: "While a high maximum capacity is desirable, yet it should not be secured by too high gear reaction. Any gear which shows more than 27,000 ft. lb. capacity should be viewed with suspicion until it is established that its reaction is not undesirably high.

"To these specifications will be added a maximum limit for gear reaction. At the present time the chronograph is felt to be the most reliable instrument for determining this, but owing to the degree of accuracy and skill required to obtain dependable results, it is not considered practicable for commercial testing."

Now, we have in the country about 2,500,000 cars and I think your draft gear committee has made a start in regard to getting a draft gear which will function properly. We will have to take care of the cars that we have to start with and establish a specification in order to know just what a draft gear should be. I think that we arrive at the point where Mr. Demarest started this morning—that we should get a suitable draft gear for the future—but the baby can't run before it walks. We will have to first establish a draft gear as a basis and then build to the ideal or the ultimate.

S. B. Andrews (C. & O.): The committee ought to be highly complimented on the work that it has done. This is something that the railroads have long needed. We have chosen draft gears too often without knowing the functions that they will perform in giving sill protection, in giving us protection for our cars. The test provides a way to get the gear that we may require, one of the most suitable for our service and need. As far as the travel is concerned, long travel is perfectly practicable provided the mechanism has enough cubical displacement to provide the necessary spring capacity and clutch mechanism to provide a device which will maintain a high working capacity and which will permit complete shock protection of car structure and lading on heavy cars moving at high switching speeds. It also provides a capacity in sturdiness, endurance and recoil.

Sill protection is the key note of the whole situation. It has not been included but I understand the committee now has it under serious consideration. It think it should be included within the elastic limit of the Type D coupler. The problem then remains to get a durable

gear which will maintain its capacity at the highest possible level and for as long a time as possible. I agree with the remarks already made by Col. Clark and Mr. Lewis, the coupler shank method of blow delivery provides an excellent method of determining the ability of any gear to protect itself and thereby best serve its fundamental purpose of protecting the car structure and lading.

L. T. Canfield (Union Draft Gear Company): I want to congratulate not only the draft gear committee, but Purdue University and the American Railway Association, for making this start on a subject that I have been very much interested in for years. I am glad of the opportunity to cooperate in this work and you may rest assured of the support of the Union Draft Gear Company at all times.

I agree heartily with Mr. Demarest as to what he said about the long travel. I think that is really necessary. It is the time element that is needed for taking care of the high speeds at which cars collide. We are limited today to 2¾-in. travel which will take care of cars up to 4 miles per hour. A half mile per hour above the closing speed of the draft gear will develop the weak spot in a car. There are just three ways of doing draft gear work: One with the draft gear, one with the car body and the other with the car lading or the body and lading both working together. If we hope to reduce car maintenance cost and damage cost due to rough handling, we have got to have better draft gears, and I think you are going to have to outline a policy of repairing your draft gears at stated intervals. I don't know how long this period should be. Possibly one year, or maybe five years, but if anyone tells you that a draft gear will run for ten years without attention and do the work you are doing today, he does not know what he is talking about. Draft gears have too much work to do every time you close them as compared with the air brake. Air brake men say that a car weighing 150,000 lb. will run 12 to 20 ft. if stopped with full brake application from a speed of 5 miles an hour which is just 25 times the distance permitted with draft gears.

Therefore, it is up to you gentlemen to keep draft gears working 100 per cent all the time, or as nearly that as possible. I don't think you ought to worry about spending a little money on draft gears when you come to consider how much you are spending on the total car maintenance. You are paying around $150 per car per year to keep your car up, and only about $44 is the natural wear and tear, this applying to the wheels, axles, etc. There is quite a spread between that and $150 that is chargeable largely to the bumping the car gets, or the failure of the draft gear to prevent damage being done the car. You can therefore, see the need for keeping the draft gear up.

C. T. Ripley (A. T. & S. F.): The committee makes reference to some road tests of draft gears to check the laboratory results. I think this is worthy of some consideration. I think all of you have had the experience, after making laboratory tests, that the manufacturers will say they feel that the test does not represent road service, particularly the man who does not come out so very well in his test.

We have always felt that wherever possible a road test should be run after a laboratory test, but three years ago we ran a series of draft gear tests with practically the identical program used by this committee. After that we applied the same types of gears to 70-ton sulphur cars which ran on our own railroad, being inspected at regular intervals. In this particular case I am glad to report that the road test results closely checked the laboratory results; that is, up to the present time. The only exception I might mention is that sticking in road tests does not seem to develop in the same way that it does in laboratory tests. Just why this is I can not say. Possibly it is the position of the draft gear; that is, horizontally in the car, whereas it is vertical in the laboratory test. This may account for the difference.

We have felt also that the reaction warranted perhaps more consideration than is given in the committee's report. The loss and damage committees are particularly interested in this subject because the draft gear has to protect the lading of the car. In running endurance tests we have used a slightly modified method as compared with that used by the committee. The committee sets a maximum blow as just under solid. We have felt that this was an unfair protection to the lighter capacity gears. When the cars are struck in the switching yards it makes no difference whether the gear has a lower capacity or a higher capacity, it has to take the blow. Therefore, in setting our upper limit in the endurance test we have used a reaction limit instead of the gear capacity. That is, we set 600,000 lb. as the maximum reaction under a blow which we would give the gear in an endurance test. The theory of this limit is that if the reaction is greater than that, something must give in the car body. Therefore, the gear punishment will not continue. The results secured under this method, as compared with the committee's method, were not very divergent, however. I merely mention this as I feel it is, perhaps, a better theory of setting the limits in the endurance test.

K. F. Nystrom (C. M. St. P. & P.): I do not believe that we have, many of us, fully comprehended the work that the gear committee has done, because of the far-reaching effect and value it will have for us in the future. The Milwaukee has been interested in draft gears and draft gear tests for a number of years along with other railroads. The tests which we have made very closely conform with the results obtained by the draft gear committee. In addition we have for several years more or less systematically inspected draft gears, and the actual conditions in service confirm the draft gear test results very closely.

We have on the Milwaukee a system of inspecting draft gears, which is in our opinion practicable. We have issued instructions, which are followed out, to inspect the draft gears simultaneously with the air brake cleaning and packing of journal boxes. For instance, for the month of May we inspected 7100 cars. Over 10 per cent of the cars inspected had defective draft gears. We have spent considerable money in replacing draft gears but we have proved to our own satisfaction that it is a paying proposition. I will give a few figures which will support this statement. In 1926, we spent $115,693 on draft gears and draft gear parts. In 1928, we spent $180,264 on draft gears and draft gear parts. In 1926 we spent $236,869 on couplers. For 1928 we spent only $105,215 for couplers. While we greatly increased the expense in draft gears and draft gear parts, we reduced the expense in couplers, so that in 1928 we spent $64,000 less on the combined coupler and draft gear parts.

It is gratifying to note the willingness of the draft gear manufacturers to cooperate with the draft gear committee, and I am fully convinced that with reasonable time the efficiency of the present draft gear in its present limited situation, or space, rather, will be im-

proved 100 per cent. In recent years we have had experience in connection with truck sides. The manufacturers cooperated with that committee and a result was obtained which no one could anticipate at the time. I feel that the draft gear committee will have the same bright future and I wish sincerely to compliment the committee. The specifications probably could be better, but if we are frank with ourselves we know very little about draft gears. There is a big field and if I sense the committee's purpose aright, it is just the feeling its way, and will come out alright.

Mr. Demarest: I don't want an impression to get in your minds that I disagree with the draft gear committee. I don't want an impression to get in your minds that I in any way decry the importance of the work that the draft gear committee has done in developing for us a knowledge of the actual operations of the gears which we did not have before. I do feel, however, that we can't blind ourselves to the fact that today, or at some time in the future, a condition has got to be met which can't be met by a draft gear redesigned on the basis of the present limited travel length and width.

I appreciate the fact that the draft gear committee in presenting its specifications for a draft gear has developed it along lines which are economical in that it will probably take the better developments in the various gears and combine them in a way which will cost less for maintenance. I am interested, of course, from the standpoint of our railroad, as you all are, in the money that it costs you to maintain equipment. Don't forget, however, that in maintenance there are two items. One is the cost of maintenance of the gear and the other is the cost of the maintenance of the car. I am not at all anxious to protect the draft gear. I am anxious to protect the car, and if that car protection is properly developed, with the development of the draft gear, we will have to have a draft gear that we can maintain economically.

I don't know whether any of you have ever asked the question, what the horn on the coupler is for? Why should it be there? The only thing we are using it for today is to help out the draft gear when it hits solid, and the end sills of the cars show the effect. I would carry the development further. We should not have to have a horn on the coupler. We ought to have a draft gear that in itself will not only protect the coupler, but will protect the car body, and the point that I am trying to make today, and that I sincerely hope will be given some attention, is not that the work of the draft gear committee shall be limited at all. Let it proceed with what it is doing.

I firmly believe that the ultimate development of the draft gear does not lie with the specifications before us today. Let the committee carry on the work and the development of the draft gear, but don't delay until that work is done, because it will be 5 or 6 years before designs can be developed and tested, and it may be longer. I sincerely hope that the two operations can be carried on at the same time, that the seven requirements can be increased to eight or possibly more, and that specifications can be developed for a gear which will not only take care of itself and the coupler, but will also take care of the car.

Mr. Gray: There seems to be an impression that we have neglected the item of reaction in these tests. I would like to point out a few places in the report which will correct that impression. In the official capacity tests, starting on page 108, those force closure diagrams are for that purpose. They show the draft gear reactions. There are 20 pages or so of those diagrams and they take in the endurance tests. You can readily see that we have not neglected this feature of draft gear reaction.

Perhaps the impression that we did neglect it comes from the fact that we did not set a desired limit for draft gear reactions. The reason for doing that is plain. We have stated our opinion that the chronograph is the only real instrument for determining reaction, but on account of the skill and accuracy required to secure dependable results with the chronograph, we do not recommend it as a practical device for taking commercial tests. Now, at the present time we have no optional method to recommend. Therefore we do not recommend a reaction test. Obviously it would be useless to recommend a reaction and then give you no means of determining it, but please bear in mind that we have determined the reaction of those gears which were tested and the results are contained in the report. Others could obtain those results if they would go to the expense we have gone to, but we do not feel like recommending that for standard practice.

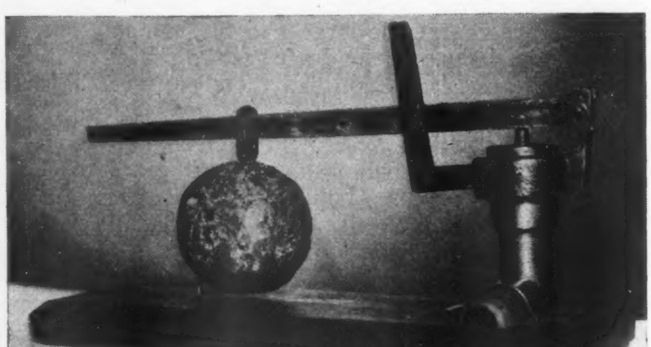
C. E. Chambers (C. R. R. of N. J.): I just want to answer Mr. Demarest's question about the purpose of the horn on the coupler. I would say it is so you would know where to find the drawbar. (Laughter) I think that if you were to remove the horn sometimes you would find the coupler under the center of the car. All you have to do is to go out in the yards and look over the cars and you will find out the draft gear is doing the work, and that is enough. I have seen cars in service over two years without a mark on the horn of the coupler, and I have seen others that had only been out about a month that showed very plainly what the horns were there for.

F. H. Hardin (N. Y. C.): I move you the adoption of the report of your Committee on Couplers and Draft Gears and in that include especially Mr. Kleine's closing remarks regarding the formulation of a proper specification in cooperation with draft gear manufacturers.

Mr. Chambers (C. R. R. of N. J.): I second the motion.

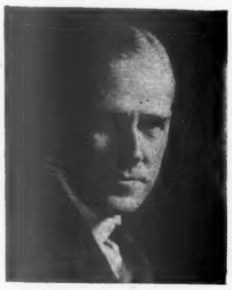
Mr. Demarest: In view of the value of the contribution which the draft gear committee has made to the American Railway Association, the most thorough investigation of the draft gear conditions which are there presented to us, I move you that the association vote them a unanimous vote of thanks.

The motion was duly seconded, put to the convention and carried by a rising vote.



The original safety valve of the John Stevens locomotive which was loaned by the Smithsonian Institute to Stevens Institute of Technology, Hoboken, N. J., at the time of Dr. Harvey N. Davis' inauguration as president of Stevens

Report on Design of Shops and Engine Terminals



W. A. Callison
Chairman

It is realized by many mechanical officers that the time is at hand when great improvements can be made in the manufacture of power, and in the arrangements for furnishing power and heat in many of the railroad shops throughout the country. There are many cases where the plants in use, for the purpose of furnishing power or heat, are so obsolete and inefficient, that they are an extensive loss to the roads owning them. There are cases where, if a thorough investigation were made, a modern plant could be constructed and the returns realized from the investment would be surprising. Many plants are operated to furnish heat only at points where but little power is required, and frequently such quantities of power can be purchased advantageously. The cost of operation and the investment necessary to furnish power in such cases prohibits its manufacture. However, many plants are operated where the power requirements, in ratio to the heating requirements, are large; and yet, such plants are operated as heating plants, and power is purchased from a utility company. Where a certain balance between these requirements exists, great economies are possible by manufacturing both power and heat.

For the purpose of making a study of a modern power plant suitable for the operation of a railroad terminal and back shop, as for example, the main shop or one of the main shops on a system, it is necessary to assume the hypothetic consists, as is believed to be typical in general extent for the purpose of power requirements.

Locomotive shops, erecting and machine shops of 24 pits.
Boiler, tin and tank shop.
Blacksmith shop.
Coach shop, capacity, 16 passenger cars.
Paint and upholstering shops.
Wheel and air-brake shops, blacksmith shop.
Mill.
Freight-car shops, 90 ft. by 600 ft.
Store house.
Office building.
Roundhouse, about 50 stalls.
Average to maximum heating requirements, 2,000 to 3,600 b.hp.

The power plant to serve this typical shop is to consist of a modern steel and brick structure, located to give the best conditions in regard to distribution of steam heat and air lines as well as convenience to tracks. The steam generating plant consists of five 400-hp. water-tube boilers, with space for one additional boiler for expansion of terminal and shops. Where the fuel is coal, boilers should be stoker fired; traveling grates for free burning coal; or retort type for coking coal, the coal to be handled by elevators and conveyors from track hoppers where cars can be unloaded with least expense. The ash should be handled by chain conveyor, steam or vacuum system to discharge into receiving hopper or directly into car. The boiler room should be equipped with modern appliances to check performance and for economical operation. The boilers are to be operated on forced draft and the waste gases removed by a stack of brick or concrete construction or induced draft.

In the engine room the proposed arrangement consists of steam-driven compound air compressors and mixed-pressure steam turbines. Fire pumps and other auxiliary apparatus may be placed in the engine room. The engine room part of plant is to be excavated for a basement. The steam turbines are to be connected on surface condensers. Condensers and auxiliary apparatus are in the basement. A spray pond or cooling tower, as an adjunct to the plant, is necessary unless an abundance of water, such as a river, is available for cooling.

The operation of the plant, in the season when no heat is required, is such that the greater portion of high-pressure steam is used to run the compressors—these in turn exhaust into the turbines at a gage pressure of about five pounds and the steam is finally exhausted to the condenser. It is necessary to add a small amount of high pressure steam to the turbine to offset condensation in the exhaust from the compressor, and it is necessary to add more high-pressure steam if the compressor load is light or the turbine load is heavy. The turbine balances this load automatically taking in the high pressure steam to effect the balance. The condenser makes it possible for the turbine to extract power from the low-pressure steam—the higher the vacuum, the more power is extracted.

In the heating season high-pressure steam is fed directly to the turbines as well as to the compressors. The compressors exhaust into the heating coils at five pounds gage or less. The greater portion of the steam is extracted from the turbines by the heating coils—that is, connections are so made that steam is exhausted at a low pressure from one of the stages of the turbine. A small portion goes to the final stage and is exhausted into the condenser.

One of the large electric manufacturing companies advises these mixed-pressure turbines will operate, for example, at full capacity or 1,000 kw. on 32,600 lb. of steam per hour at 200 lb. gage and 100 deg. superheat, and that 31,400 lb. per hour at 7 lb. gage can be extracted and used in the heating system. At one-half capacity or 500 kw., this turbine will operate on 18,000 lb. of steam per hour and 17,000 lb. can be extracted. This is called extraction operation.

These machines can also be operated on mixed pressure. At full capacity, or 1,000 kw., the theoretical consumption is 31,600 lb. and at one-half capacity or 500 kw., the consumption is 20,000 lb. of low-pressure steam. It is doubtful, however, if this kind of operation is desirable for the reason that the low-pressure steam contains some water and has the effect of cutting and wearing the blades. This can be prevented by mixing a small amount of high-pressure steam. A combination or mixture as follows should give good results: At 1,000 kw., 28,000 lb. of low-pressure and 2,000 lb. of high-pressure steam, and at 500 kw., 18,000 lb. of low-pressure and 1,000 lb. of high-pressure steam per hour. This is called mixed-pressure operation. The operation, of course, depends upon conditions and upon the skill and understanding of the apparatus by the operator.

It is estimated that a plant as described in the foregoing can be built for a total cost of from $400,000 to $450,000 depending on local conditions, quality of component parts and modern devices, instruments, etc., included. Assume that the cost is $415,000—divided $190,000 for the boiler room and $225,000 for the engine room—and further assume that the cost of wages is $1,200 per month.

In attempting to estimate the cost of current and cost of steam manufactured by a hypothetical plant such as suggested the committee is mindful of the difficulty of obtaining reliable and authentic data, that the cost of diverse items according to location and season, etc., and the cost of units of output varies with the amount or quantity because of certain fixed charges being more or less constant. It is believed, however, that the figures shown are fair averages and that the report will be helpful in checking up power and heating costs. Each item can be checked and verified without difficulty to compare with localized and special conditions.

Cost of Steam

There are certain fixed charges in a plant of this kind which remain almost constant regardless of the power produced. The fixed charges for the boiler plant only are:

Interest on Investment	$190,000	@ 6 per cent	$11,400
Depreciation		@ 4 per cent	7,600
Repairs		@ ½ per cent	950
Supplies		@ ½ per cent	950
Taxes and Insurance		@ 1 per cent	1,900
Wages (for portion of boiler operation $800 per month)			9,600
The yearly overhead charges for boiler plant only			$32,400

These charges will remain approximately the same whether the plant is running at full capacity or half capacity. The mean or average output will govern the average cost of steam. There are other items which vary with the output. The main one of these is cost of coal. Water also is a variable item and will be dealt with later.

The cost of steam is customarily expressed in cents per 1,000 lb. delivered. It is evident that the quality of steam delivered

affects this cost, all other things being equal. For example: High-pressure highly superheated costs more per pound than low-pressure saturated steam, because it contains more heat. All of the steam produced by the boilers, however, can not be delivered through the steam mains. Some part of that is required to operate auxiliary apparatus. This quantity will be taken at 10 per cent so that only 90 per cent is actually delivered and the cost must be figured on that basis, in this example. The overhead charges can be expressed in cost per day or cost per hour and are respectively $88.79 and $3.70.

The boilers considered in this report are assured to be of the latest design equipped with stokers and fuel-saving devices to give a maximum of guaranteed efficiency, but it is realized that such maximum efficiency cannot obtain in a range of operation from less than 100 per cent rating of the boiler to 200 per cent. It is safe to say, however, that with a rating of from 75 per cent to 175 per cent of the commercial boiler rating, an average of 73 per cent combined efficiency of the furnace and boilers should be obtained, without difficulty, in an up-to-date installation, with competent attendants. The plant is designed to burn low-grade, cheap coal, such as screenings, etc. These vary, of course, depending on location, but assuming coal from the midwestern belt of Indiana and Illinois, screenings with a value of 11,500 B.t.u., will be considered. The proposed operation of this plant is to furnish steam at 200 lb. gage pressure and a temperature of 500 deg. The reason for choosing this pressure and temperature is that the manufacturers of valves and fittings make a demarkation in the conditions for which such valves and fittings are suited. The next step higher in quality of fittings increases the cost of this material to a very great extent. The heat content of such steam is figured at 1,086 B.t.u. per pound—bearing in mind that the feed water is returning to the boilers at or near 212 deg., that this is possible by using steam from auxiliary apparatus, for the feed water heaters—the steam used in auxiliary apparatus to be deducted from steam generated and as before mentioned, this is to be 10 per cent. Therefore, the heat recovered from this apparatus will be direct gain. The amount of water evaporated per pound of coal is: $11{,}500 \times .73 \div 1{,}086 = 7.73$.

(Under these conditions, the committee presents a table showing that, with coal at $2 per ton, the cost of steam per 1,000 lb. delivered to the main varies from 26.6 cents at 50 per cent of commercial rating—all boilers working—to 17.2 cents at 200 per cent commercial rating. With coal at $5 a ton the cost varies from 48.4 cents per 1,000 lb. at the main to 38.5 cents for the same ranges of loading.—Editor.)

Cost of Power

The same conditions in regard to fixed charges, of course, also apply to the business of producing power. Therefore, the fixed charges for the power end of this plant are:

Interest on Investment	$225,000	@ 6 per cent	$13,500
Depreciation		@ 4 per cent	9,000
Repairs		@ ½ per cent	1,125
Supplies		@ ½ per cent	1,125
Taxes and Insurance		@ 1 per cent	2,250
Yearly wages (for portion of power operation $400 per mo.)			4,800
The fixed charges for the engine room are			$31,800

The overhead charges amounting to $31,800 per year, can be expressed in cost per day or per hour and will respectively be $87.12 and $3.63.

These overhead charges will remain nearly the same, regardless of the amount of power produced. The plant is designed to produce compressed air and electrical energy. The compressors—two 3,500 cu. ft. per min. capacity, and one 1,000 cu. ft. per min. capacity to operate to compress air to 110 lb.—are to be compound steam engines or may be of the unaflow type. In the non-heating season they will exhaust into the turbine and in the heating season into the heating system. It is the opinion of this committee that, for this size of plant, they are of sizes best suited to the conditions generally to be met in railroad-shop operation. The two 3,500-cu-ft. machines should be large enough to cope with the heaviest loads encountered. Under certain conditions, one of these units would carry the load and under other conditions, one large and the smaller 1,000-cu. ft. machine would be able to carry the load. There is also the advantage of being able to overhaul and repair any one unit, without crippling the shop operation.

What has been said about the compressors, size of units, etc., should generally also be true as to the turbo-generators. The generators, two in number of 500 kw. and 1000 kw. capacity, should be suitable for 440 volts, if the distances to where the power is used are not excessive. The current is carried to the switchboard within the power room or as may be thought convenient and distributed from there. Transformers are to be used where lighting circuits are connected. It may be advisable to install a small d.c. unit to meet certain conditions. The costs given in the following table, are based on theoretical efficiencies. The cost of air which is expressed in cost per 1000 cu. ft. of free air, compressed to 110 lb. gage pressure is based on .185 hp. required for two-stage compression. The quantity, 1000 cu. ft. of free air compressed per minute, is therefore equal to the rate of 185 hp. The variation in cost is dependent on the cost of steam per 1000 lb. and upon the quantity produced. The cost of electrical energy is based on theoretical consumption of steam of the turbines. The variation in cost depends on the cost of steam per 1,000 lb. and upon the quantity produced.

It can readily be seen that costs rise with the cost of steam but rise very high when production is low. It, of course, is not possible to say what should be the exact cost of power, it depends on too many things. Your committee, however, will endeavor to show what the cost of power and heat would approximate under given conditions assumed. These figures can be used for comparison and check, in all of the several items, which constitute the total and final values.

Cost in Cents of Compressed Air, Per 1000 Cu. Ft. of Free Air Compressed to 110 Lb., and Cost of Electrical Energy Under Varying Cost of Steam and Output When Exhaust Steam is Used for Heating

Approx. cost of steam per 1000 lb., cents	6000 cu. ft. of air per minute	1000 kw. per hour	3000 cu. ft. of air per minute	500 kw. per hour	1000 cu. ft. of air per minute	166 kw. per hour
			Winter Season			
17	.6662	.2963	1.1702	.4990	3.2050	1.3225
18	.6758	.3029	1.1798	.5070	3.2160	1.3365
21	.7042	.3234	1.2082	.5310	3.2480	1.3775
24	.7330	.3435	1.2370	.5550	3.2800	1.4186
27	.7615	.3637	1.2655	.5790	3.3110	1.4597
30	.7900	.3840	1.2940	.6030	3.3430	1.5007
33	.8190	.4043	1.3230	.6270	3.3750	1.5420
36	.8490	.4245	1.3530	.6510	3.4070	1.5830
40	.8855	.4515	1.3895	.6830	3.4490	1.6370
48	.9620	.5056	1.4660	.7470	3.5340	1.7470
			Summer Season When Turbines Are on Mixed-Pressure Operation			
17	.9860	.4452	1.4900	.6895	3.5610	1.5735
18	1.0140	.4606	1.5180	.7087	3.5920	1.5998
21	1.1000	.5072	1.6040	.7664	3.6870	1.6864
24	1.1840	.5537	1.6880	.8240	3.7810	1.7716
27	1.2700	.6002	1.7740	.8816	3.9050	1.8758
30	1.3540	.6468	1.8580	.9393	3.9700	1.9420
33	1.4390	.6933	1.9430	.9969	4.0650	2.0272
36	1.5240	.7494	2.0280	1.0545	4.1590	2.1124
40	1.6380	.8019	2.1480	1.1314	4.2850	2.2260
48	1.8640	.9259	2.3680	1.2740	4.5350	2.4532

Opinions may vary as to the advisability of operating steam-driven air compressors. The advantage in this is a possible lower first cost and slightly lower cost of operation. The disadvantages are cylinder oil in the exhaust and consequently in the turbines and the heating system, unless caution is used, first in reliable oil removers and second in the operation.

The advantage in operating steam turbo-generator and motor-driven compressors is freedom from the above annoyances, but the overall efficiency on the compressors is sure to be less and consequently will result in higher cost per 1000 cu. ft. of air. The first cost will likely be higher, because of more units or larger units of turbines and condensors.

For the purpose of giving a more concrete idea of these figures and to make it possible to check and compare costs against existing plants, it is assumed that the hypothetical plant is operated through a year's time and that the cost be shown. A set-up of given conditions, of course, is necessary, and these conditions are thought to be within reasonable limits. It is believed that for a shop and terminal layout, as suggested in this report, the following approximate quantities and heat would be required.

Conditions For the Winter Months

Power in kilowatt-hours	1,600,000
Compressed air	480,000 M. cu. ft.
Heat in 1000 lb. of steam	280,000 M. lb.
High-pressure steam for round house	45,000 M. lb.

These figures are based on 181 days operation.
Full working days @ 8 hrs. 151 days.
Holidays .... 30 days.

The compressors are working on an average load of 4,500 cu. ft. per minute, 8 hours times 151 days. The small unit is on an average load of 800 cu. ft. per minute the balance of the time; that is, 16 hours times 151 days and 24 hours times 30 days.

Cost of Operation

23,050 tons of coal @ $2.00	$46,100.00
Fixed charge, boiler room, 181 days	16,060.00
Fixed charge, engine room, 181 days	15,760.00
Total cost winter months	$77,920.00

The average rate of output of the boilers is found as follows: 325,000 M lb. of steam required for heat and power. Ten per cent of the gross output is required for auxiliary apparatus. 325,000 M times 1.111 equals 361,000 M lb. and 361,000 M times 1986 divided by 33,500 times 4,344 divided by 1086 is 2,700 b. hp. nearly. At this rate the cost per 1,000 lb. of steam is 19.12 cents.

The average hourly output of the turbo-generators is 1,600,000 kw.-hr. ÷ 4,344 hours = 368 kw. These machines are working on the same hour arrangement as the compressors: 800 kw. in the eight hour day and 200 kw. for the balance of the time.

The average hourly output of the compressors is: 480,000 M cu. ft. ÷ 4,344 = 110,400 cu. ft. per hour or 1,840 per minute. The approximate cost can be found in the table—for a check only. It is better to calculate it. The rate of cost of electric energy is .6642 cents per kw. hr. and of compressed air is 1.83 cents per 1,000 cu. ft. compressed.

The total heating requirements in this case are, of course, assumed.

The total value of products in this period, then is:

1,600,000 kw. hours @ .6642 cents	$10,620
480,000 M cu. ft. compressed air @ 1.83 cents	8,780
87,000 M lb. exhaust steam (htg.) @ 19.12 × .8233 cents	13,680
193,000 M lb. high pressure steam (htg.) @ 19.12 cents	36,900
45,000 M lb. high pressure steam (round house) @ 19.12 cents	8,600
Total value of products	$78,580

which amount balances closely with the cost.

The steam to the enginehouse, other than heating, is based on the number of engines turned and is assumed to be 100 per day. The amount of steam per engine is 3,000 lb. The steam is for the blower lines, washout pump service, etc. The heating load makes up the balance of the requirements. A portion of the steam used for heating is exhaust steam, depending on the requirements for power. The average rate of output of the boiler plant in this case is about 83,000 lb. of steam per hour. The average requirement for power is about 19,300 lb. per hour. The maximum requirement is nearly 70,000 lb. per hour. The steam used in the power engines is charged according to the amount of heat available to the engines and the balance of the heat is charged to heating. Where insufficient exhaust steam is available for heating, high-pressure steam to augment the demand must be charged at full cost. For the summer months:

Power in kilowatt-hours	1,622,000
Power in compressed air in 1000 cu. ft.	486,000 M cu. ft.
High pressure steam, in 1000 lb. for round house	45,000 M lb.
These figures are based on 184 days operation.	
Full working days @ 8 hrs. 154 days.	
Holidays	30 days.

These compressors are working on an average load of 4,500 cu. ft. per minute, 8 hours times 154 days. The small unit on an average load of 800 cu. ft. per minute the balance of the time. That is, 16 hours times 154 days and 24 hours times 30 days. The average output of compressed air is 486,000,000 ÷ 4416 hr. = 110,000 per hour or 1830 cu. ft. per minute nearly. The turbo-generators are working at a load of 800 kw. 8 hrs. times 154 days; and 16 hrs. times 154 days, plus 24 hrs. times 30 days at a load of 200 kw. This totals approximately 1,622,000 and divided by 4416 is an average output of 368 kw. The cost of operation is:

6,460 tons of coal @ $2.00	$12,920
Fixed charges, boiler room 184 days	16,340
Fixed charges, engine room 184 days	16,040
Total cost summer months	$45,300

The average cost of air per 1000 cu. ft. compressed, is approximately 2.577 cents. The cost of electric energy is approximately 1.3 cents per kw.-hr.

The total value of products is:

1,622,000 kw. hrs. @ 1.3 cents	$18,300
486,000 M. cu. ft. of compressed air @ 2.577 cents	12,520
45,000 M. lb. high pressure steam (round house) @ 32.1 cents	14,450
	$45,300

which agrees closely with the cost.

The report was signed by W. A. Callison (chairman), superintendent motive power, Chicago, Indianapolis & Louisville; J. M. Henry, assistant chief motive power, Pennsylvania; B. P. Phelps, engineer shop extensions, Atchison, Topeka & Santa Fe; J. A. Brossart, general master car builder, Cleveland, Cincinnati, Chicago & St. Louis; J. Burns, works manager, Canadian Pacific; G. F. Hess, superintendent motive power, Wabash; A. M. McGill, assistant superintendent motive power, Lehigh Valley.

Discussion

[In the absence of Chairman Callison, the report was presented by B. P. Phelps (A. T. & S. F.)—Editor.]

On motion, the report was accepted and the committee continued.

Report on Specifications and Test for Materials

F. M. Waring
Chairman

Your committee submits the following report on subjects before it during the past year.

Revision of Standard Specifications

Exhibit A.—Specifications for Gaskets for Air Brake Hose: In view of some trouble that has been experienced with inferior quality of gaskets which, however, met the low physical requirements of the present specifications and, because the gaskets as furnished by the majority of manufacturers have higher physical properties, it is desirable to bring the specifications up to the present state of the art and eliminate the lower quality gaskets. Accordingly it is recommended that Section 4, Tension Test, be changed to increase the requirements for tensile strength and elongation as shown below (the present requirements being shown in brackets).

4. Tension Test—Gaskets shall be subjected to a tension test by inserting into the gasket two semi-circular blocks, each having a 180-deg. fillet of the same radius as the original inner radius of the gasket, and pulled at a speed of 20 in. per minute. Under this test the gasket shall show a minimum tensile strength of 150 [90] lb. and a minimum elongation of 275 [200] per cent.

Revisions of Recommended Practice Specifications

Exhibit B.—Specifications for Cast Steel Truck Side Frames; *Exhibit C.*—Specifications for Bolsters; *Exhibit D.*—Specifications for Coupler Yokes. As a result of co-operation between representatives of the Car Construction Committee, the manufacturers and the Specifications Committee, the present joint specifications for Side Frames, Bolsters and Coupler Yokes, have been revised and separated for more convenient use. This was principally due to changes in the Side Frame Specifications whereby the material has been limited to cast steel and the physical test requirements have been raised. The Bolster and Coupler Yoke Specifications are the same as now appearing in the Manual with a slight increase of physical requirements for the Bolsters and certain changes of form in both specifications.

It is thought proper to call the attention of the Association to the increased physical requirements for the side frame tests with the statement that these requirements are being met by

certain designs now furnished but that a number of designs of frame now in service will have to be gone over and strengthened in order to meet these requirements. This is no reflection on the adequacy of the present design for the service, but the improvement in the design and manufacture of side frames has warranted increasing the requirements to agree more nearly with modern practice and the old designs should be made obsolete or strengthened accordingly.

The test requirements have been limited to static tests as in the present specifications. Some consideration was given to the desirability of including a fatigue test to be made at the option of the purchaser but due to the fact that neither the Association nor any of the member railroads possessed facilities for making such tests, your committee felt that a fatigue test requirement would be impracticable at this time. Some fatigue tests on side frames have been conducted by the Car Construction Committee and by individual railroads, but the subject is one which requires further study. Your committee believes that active consideration should be given to the merits of this method of testing side frames and would be glad to co-operate with the Car Construction Committee, or to act separately, if approved by the Association, in an investigation with a view to making definite recommendations at as early a date as may be possible.

New Specifications—Recommended Practice

Exhibit E.—Specifications for Carbon Steel Forgings, Normalized and Drawn. These specifications have been prepared on the basis of experience of some of the members and in view of the demand for forgings with higher physical properties than can be obtained under the present Specifications for Annealed Forgings. These specifications are offered as representative of the grade of forgings that is coming into more general use each year in the field of parts subject to reversing stresses or where a material with higher elastic limit and ductility is desired.

Exhibit F—High Chrome Steel Rivet Material and Rivets for Nitric Acid Tank Cars.

Exhibit G—High Chrome Steel Seamless Tubing for Nitric Acid Tank Cars.

Exhibit H—High Chrome Steel Castings for Valves for Nitric Acid Tank Cars.

Exhibit I—High Chrome Steel Tank Plates for Nitric Acid Tank Cars.

These specifications have been prepared on the request of the Committee on Tank Cars to cover material suitable for building nitric acid tank cars. Your committee has had no experience with such material but has used the practice of the du Pont Company as a basis for these specifications, and has also obtained some helpful suggestions from several manufacturers of the material.

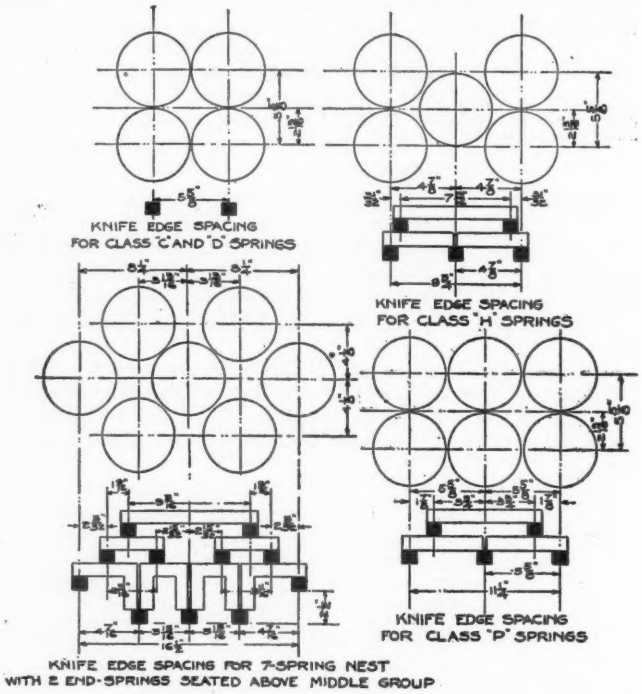


Fig. 1—Recommended method for vertical test loading of truck side frames, showing knife-edge spacing

Exhibit B—Specifications for Truck Side Frames, Cast Steel

1. *Scope.*—These specifications cover cast steel side frames for freight equipment with integral or separable journal boxes.

2. *Material.*—Shall be of cast steel in accordance with Grade "B" of A. R. A. specifications for steel castings, which form a part of these specifications.

3. *Design.*—(a) The basis of design shall be the axle capacity "C." The maximum combined unit stress in the design shall not exceed 16,000 lb. per sq. in. The vertical design load shall be taken as acting on the spring base (or its equivalent, for test) and shall be 1½ C. The transverse load shall be taken as acting on the bolster guides, one-half on each

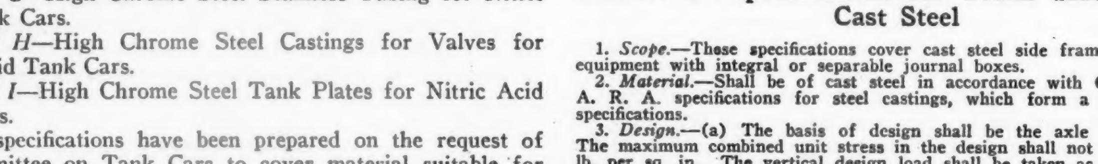


Fig. 2—Method of transverse test loading for cast steel tr uck side frames

guide—on a line located above the nominal center line through the two axles, an amount equal to the journal diameter of axle less 1½ in., and shall be 0.4 C.

(b) "T" sections, angles and vertical web I-beam sections are prohibited under these specifications.

4. *Test Requirements.*—(a) The basis of test for side frames shall be the axle capacity (C) in accordance with the values given in Table I.

Table I

Size of journal, in.	C—Capacity of axle (lb.)	Type of truck
5 x 9	32,000	2C
5½ x 10	40,000	2D
6 x 11	50,000	2E
6½ x 12	6[illegible],000	2F

(b) The vertical test load shall act on the spring base, or its equivalent. The transverse load shall act on the bolster guides, one-half on each guide, on a line located above the nominal center line through the two axles, an amount equal to the journal diameter of axle less 1½ in.

(c) The deflection measuring instruments shall be located midway between supports of specimen and shall be set at zero under an initial load of 5,000 lb. In the vertical test only a load of 20,000 lb. shall be applied to the frame for five minutes, and then released to 5,000 lb. The load for the deflection measurement shall be 5,000 lb. additional to the load shown in Table II, but the load for the permanent set and minimum breaking load shall be as given in Table II.

5. *Tests.*—(a) At least two specimens of each new design shall be tested on a suitable static testing machine. The vertical and transverse tests shall be made separately. In the case of separable journal boxes, the boxes and parts shall be assembled and bolted into place for the vertical test only.

(b) Side frames shall comply with the requirements shown in Table II.

Table II

	Side frames	
	Vertical, lb.	Transverse, lb.
Load for zero setting of instrument........	5,000	5,000
Load at 0.04 in. maximum deflection......	2.25C	....
Load at 0.07 in. maximum deflection......	....	0.60C
Load at 0.01 in. maximum permanent set....	4.50C	1.20C
Minimum breaking load	12C	....

6. *Loading Diagrams.*—Fig. I shows the recommended method of vertical test loading. The knife edges shall be located in accordance with the spring grouping as shown. Fig. 2 shows the method of transverse test loading.

7. *Marking.*—In addition to the requirements for marking given in A. R. A. Specifications for Steel Castings, all truck side frames shall bear the cast letters A. R. A. followed by the date of issue or re-issue of this specification to which they conform.

Exhibit C—Specifications for Truck Bolsters

1. *Scope.*—These specifications cover truck bolsters for freight equipment with either integral or separable center plate.

2. *Material.*—May be of cast steel, structural steel, or forged iron or steel, in accordance with A. R. A. specifications.

3. *Design.*—All standard fundamental A. R. A. requirements, not specifically mentioned herein, shall also govern.

Table III

Size of journal, in.	Type of truck	Vertical load = P, lb.
5 by 9	2C	62,000
5½ by 10	2D	77,000
6 by 11	2E	96,000
6½ by 12	2F	115,000

The basis for the calculation of maximum combined unit stress shall be the vertical load equal to "P" as given in Table III, and the transverse load equal to 0.25 P.

The vertical load shall be taken as acting on the center line of the bolster anywhere within 8 in. each side of the center of the bolster; also anywhere from the center of spring support to a point 23 in. from the center of the bolster. The section moduli shall decrease uniformly from the section 8 in. from the center to the section 23 in. from the center of the bolster. The transverse load shall be taken as acting on the neutral axis (or, for test, on a line 5 in. below the center plate bearing face), and shall be applied only at the center of the bolster. On this basis of calculation for checking relative designs, the maximum combined unit stress in the design shall not exceed 16,000 lbs. per sq. in., and the maximum unit stress for vertical or transverse loads considered separately shall not exceed 12,500 lbs. per sq. in. for vertical load equal to "P" or horizontal load equal to 0.8P.

4. *Test Load Requirements.*—(a) At least two specimens of each new design shall be tested on a suitable static testing machine. The two specimens selected shall be good average product.

(b) Bolsters shall comply with the requirements in Table IV, the vertical and transverse tests to be made separately. The vertical loads shall be applied separately at center plate, and at one side bearing.

Table IV

	Vertical		
	Center plate (lb.)	Side bearing (lb.)	Transverse (lb.)
Load for zero setting of instrument.....	5,000	5,000	5,000
Load at 0.055 in. max. deflection.......	....	1.5P	....
Load at 0.075 in. max. deflection.......	1.5P	....	1.0P
Load at 0.025 in. max. permanent set...	3.0P	2.5P	2.0P
Maximum load not less than............	5.5P	....	....

(c) The deflection measuring instruments shall be located midway between supports of specimen, and shall be set at zero under an initial load of 5,000 lb. after a load of 20,000 lb. has been applied for five minutes and then released to 5,000 lb. The load for the deflection measurement shall be 5,000 lb. additional to the load shown in Table IV, but the load for the permanent set and maximum load shall be as given in Table IV.

5. *Loading Diagrams.*—Fig. 3 shows the recommended method for vertical test loading and Fig. 4 for transverse test loading of truck bolsters.

Exhibit D—Specifications for Coupler Yokes

1. *Scope.*—These specifications cover coupler yokes of either horizontal or vertical plane types for freight equipment.

2. *Material.*—May be of cast steel, structural steel, or forged iron or steel, in accordance with A. R. A. specifications.

3. *Design.*—Each coupler yoke design intended for use with type "D" coupler and 6 in. x 1½ in. key, shall meet the following design requirements; if made from Grade "A" cast steel, or its equivalent, the tension area shall not be less than 12 sq. in.; and if made of Grade "B" steel, or its equivalent, the tension area shall not be less than 10½ sq. in.

4. *Test Requirements.*—(a) At least two specimens of each new design shall be tested on a suitable static testing machine.

(b) The method of support and loading shall be equivalent to service conditions on tangent track. The maximum set shall not exceed .031 in. under a load of 325,000 lb. The breaking load shall not be less than 550,000 lb. The set shall be taken in the length from the rear follower bearing face on the yoke to the front coupler key bearing face.

(c) The deflection measuring instruments shall be set at zero under an initial load of 5,000 lb. after a load of 20,000 lb. has been applied for five minutes and then released to 5,000 lb.

5. *Loading Diagrams.*—Figure 5 indicates the recommended method for testing of yokes and taking the measurement determining the maximum set.

Exhibit E—Specifications for Normalized and Drawn Carbon—Steel Forgings

1. *Scope.*—These specifications cover normalized carbon steel shafts, driving, engine truck and trailer axles, crank pins, main and side rods, piston rods, straps and other steel forgings for locomotives and cars as may be specified on the order.

2. *Basis of Purchase.*—(a) The manufacturer shall employ the normalized and drawn method of heat treatment.

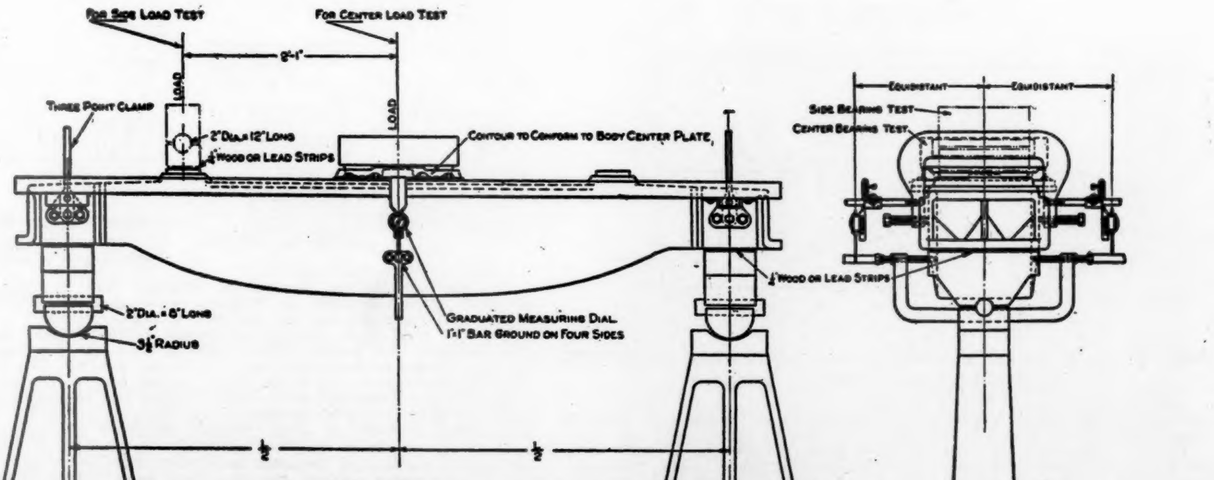


Fig. 3—Method of vertical test loading for truck bolsters

(b) Quenching in any liquid medium will not be permitted under these specifications.

3. Process.—The steel shall be made by the open-hearth or other process approved by the purchaser.

4. Discard.—A sufficient discard shall be made from each ingot to insure freedom from piping and segregation.

5. Forging Practice.—The forgings may be made direct from the ingot or from billets, the total reduction from ingot to forging being not less than three to one.

Carbon	0.40-0.55	per cent
Manganese	0.60-0.90	per cent
Phosphorus, not more than	0.045	per cent
Sulphur, not more than	0.05	per cent
Silicon, not less than	0.15	per cent

(b) The steel shall not show residual allowing metal impurities in excess of the following limits:

Chromium	0.15	per cent
Nickel	0.25	per cent

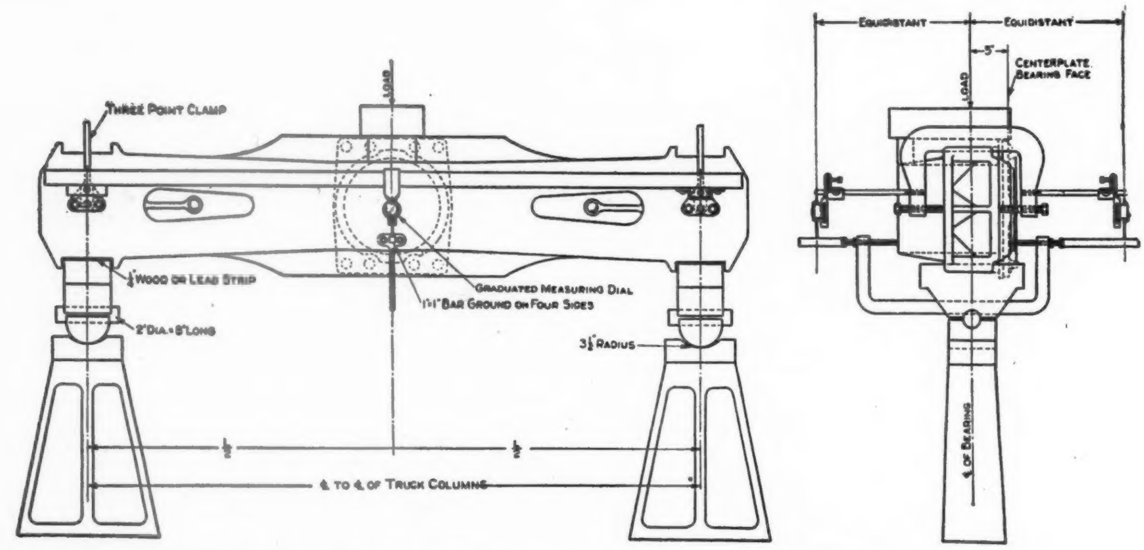


Fig. 4—Method of transverse test loading for truck bolsters

6. Prolongation for Test.—Full sized prolongation shall be left on at least 20 per cent of the forgings for test purposes. For forgings with large ends or collars the prolongation may be of the same cross-section as that of the forgings back of the large end or collar.

7. Heat Treatment.—(a) After forging, the forgings shall be allowed to cool to below the critical range and shall then be subjected to a heat treatment consisting of normalizing and drawing as specified in this section.

(b) For normalizing, the forgings shall be uniformly heated to a proper temperature to refine the grain and after being held a sufficient length of time at this temperature, shall be withdrawn from the furnace and allowed to cool in the atmosphere to below the critical range, protected from rain

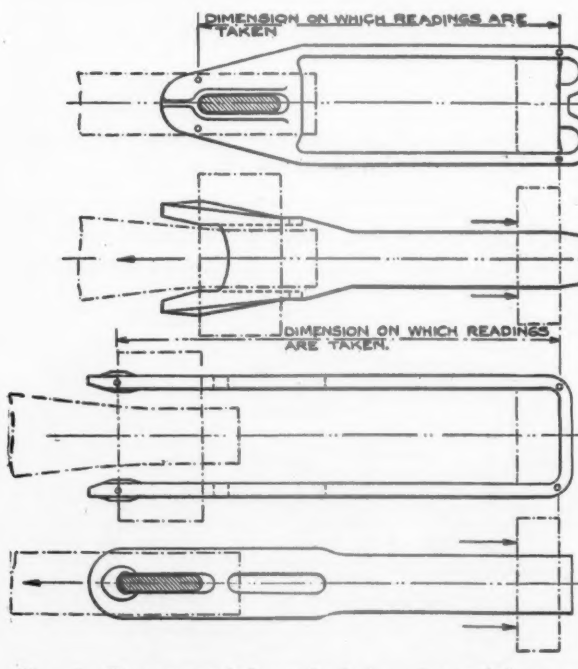


Fig. 5—Recommended method for determining maximum permanent set of coupler yokes

or snow. A group of forgings thus heated shall be known as a "normalizing charge."

(c) For drawing back, after the previous treatment, the forgings shall be uniformly heated to a temperature below the critical range, and after being held a proper length of time at this temperature, shall be allowed to cool uniformly either in the furnace or in the atmosphere, protected from rain or snow. A group of forgings thus treated shall be known as a "draw-back charge."

8. Chemical Composition.—(a) The chemical composition of the forgings determined from samples taken as described in Section 10 shall conform to the following:

9. Ladle Analysis.—An analysis of each melt of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus, sulphur and silicon. This analysis shall be made on drillings taken at least ¼ in. beneath the surface of the test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser, and shall conform to the requirements specified in Section 8.

10. Check Analysis.—(a) An analysis may be made by the purchaser from a forging representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 8. Drillings for analysis may be taken with a ⅝-in. drill from the forging or from a full-sized prolongation of the same, at any point midway between the center and surface of solid forgings, and at any point midway between the inner and outer surface of the wall of bored forgings; or turnings may be taken from a test specimen.

(b) In addition to the complete analysis specified in paragraph (a), a carbon determination may be made by the purchaser on drillings taken with a ⅝-in. drill from the center of the forging or full-sized prolongation of the same, to determine by the variation in carbon the amount of segregation. This determination shall show the carbon content to be within 12 per cent of the amount found at any point midway between the center and surface. This requirement does not apply to bored forgings.

11. Tension Tests.—(a) The forgings shall conform to the following minimum requirements as to tensile properties:

NORMALIZED AND TEMPERED

Size Outside diameter or overall thickness	Tensile strength lb. per sq. in.	Yield point lb. per sq. in.	Elongation in 2 in., per cent: Inverse ratio	Elongation: Not under	Reduction of area, per cent: Inverse ratio	Reduction: Not under
Not over 8 in. diameter or thickness, 4 in. max. wall	85,000	.52 T.S.	2,300,000 / Tens. Str.	25	3,650,000 / Tens. Str.	40
Over 8 in. to 12 in. outside diameter or thickness, 6 in. max. wall	83,000	.52 T.S.	2,100,000 / Tens. Str.	24	3,320,000 / Tens. Str.	38
Over 12 in. to 20 in. outside diameter or thickness, 10 in. max. wall	83,000	.52 T.S.	2,000,000 / Tens. Str.	23	3,100,000 / Tens. Str.	36

(b) The classification by size of forgings shall be determined by the specified finished diameter or thickness which governs the size of the prolongation from which the test specimen is taken.

(c) The yield point shall be determined by the drop of the beam or by the dividers; the method being optional with the purchaser, and at a crosshead speed of from 1/16 in. to ¼ in. per minute. The tensile strength shall be determined at a speed not to exceed 1½ in. per minute.

12. Tension Test Specimens.—(a) Tension test specimens shall be taken from the full-sized prolongation of any forging, or at the option of the manufacturer, from an extra forging furnished for the purpose. The axis of the specimen shall be located at any point midway between the center and surface of the solid forging or full-sized prolongation, and at any point midway between the inner and outer surface of wall of bored forgings, and shall be parallel to the axis of the forging in the direction in which the metal is most drawn out.

(b) Tension test specimens shall conform to dimensions shown in Fig. 6. The ends shall be not less than ⅞ in. in diameter, and of a length and form to fit the holders of the test machine in such a way that the load shall be axial.

Note:—The gage length, parallel portions and fillets shall be as shown, but the ends may be plain or threaded.

13. Micrographic Tests.—(a) A specimen representing each class by size of each melt of each heat treated lot, shall be taken for microscopic tests from the tension test specimen. The sections for microscopic tests shall be cut from the large undistorted portion of the test specimen in such a way as will give one face normal and one face parallel to the axis of the specimen.

(B) Both faces shall be polished practically free from scratches. The transverse face shall be etched with 4 per cent solution of nitric acid in alcohol. The longitudinal face to be left unetched. The specimen shall be examined under a magnification of 100 diameters.

(c) The whole of the transverse section shall show uniform, well broken up, fine grained structure. Only one irregular mesh as large as ½ in. in diameter shall be permitted in a field 3 in. in diameter.

(d) For information only, the longitudinal unetched face will be examined for solid non-metallic impurities and should show such impurities well scattered over the field.

14. Macroscopic Test.—For information only, a coupon taken with a fore drill or sawed normal to the axis of the forging shall be cut from the prolongation from which drillings for chemical analysis are obtained. This coupon representing one-half of the diameter of the prolongation shall be marked before detaching to indicate direction of forging and shall be used for macroscopic examination.

15. Number of Tests.—(a) One tension and one microscopic etch test, and for information only, one microscopic unetched and one macroscopic etch test shall be made from each class by size of each melt of each heat treated lot.

(b) If the test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(c) If the percentage of elongation of any tension test specimen is less than that specified in Section 11, and any part of the fracture is more than ¾ in. from the center of the gage length, as indicated by scribe scratches marked on the specimen, a retest shall be allowed.

(d) If the results of the tests of any lot do not conform to the requirements specified, the manufacturer may retest such lot, but not more than three times, and retests shall be made as specified in Sections 11 and 13.

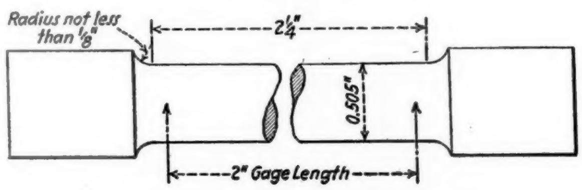


Fig. 6—Normalized forging test specimen

16. Workmanship.—The forgings shall conform to the sizes and shapes specified by the purchaser. When centered, 60-deg. centers with clearance drilled for points shall be used. When forgings are drilled from both ends, and the hole thus drilled is out of line, the diameter of the hole may be increased by boring or reaming in order to make the hole smooth and continuous, but the diameter of the hole shall not be increased more than ⅛ in.

17. Finish.—The forgings shall be free from injurious defects and shall have a workmanlike finish.

18. Marking.—(a) The forgings shall have the manufacturer's identification marks, melt number, forging number and date legibly stamped on each forging with steel stencils at such location as shall be designated by the purchaser with letters and figures not less than ⅜ in. high. In case it is necessary to move the above markings, due to machining, it may be done only after permission has been obtained from the inspector.

(b) After the material has been inspected the inspector shall stamp each accepted forging with his private mark.

19. Inspection.—(a) The inspector representing the purchaser shall have free entry at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the forgings ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the forgings are being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment unless otherwise specified, and shall be so

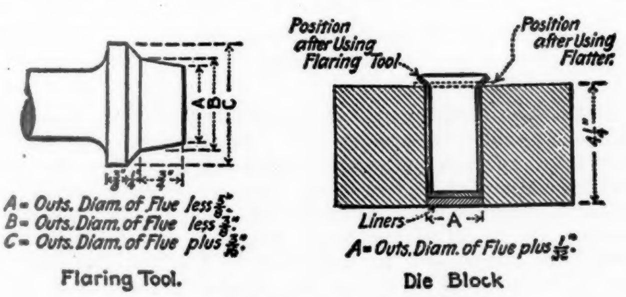


Fig. 7—Flaring tool and die block

conducted as not to interfere unnecessarily with the operation of the works.

(b) The purchaser may make the tests to govern the acceptance or rejection of the forgings in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

20. Rejection.—(a) Unless otherwise specified, any rejection based on tests made in accordance with Section 19 (b) shall be reported within five working days from the receipt of samples.

(b) Forgings which show injurious defects while being finished by the purchaser will be rejected, and the manufacturer shall be notified.

21. Rehearing.—Samples tested, in accordance with Section 19 (b), which represent rejected forgings, shall be preserved for two weeks from the date of test report.

High Chrome Steels for Nitric-Acid Tank Cars

Four specifications are submitted for materials used in the construction of nitric acid tank cars as follows:

Exhibit I—Tank Plates
Exhibit F—Rivets and Rivet Materials
Exhibit G—Seamless Tubing
Exhibit H—Castings

In all cases the steels are to be produced by the electric furnace process. The following chemical properties are specified, the amounts being in per cents:

	Plates, Rivets, Tubing	Castings
Carbon	Max. 0.12	Max. 0.35
Manganese	Max. 0.50	Max. 0.70
Phosphorous	Max. 0.025	Max. 0.035
Sulphur	Max. 0.025	Max. 0.035
Nickel	Max. 0.40	Max. 0.40
Silicon	Max. 1.10	Max. 1.10
Chromium	Min. 16	Min. 16

Plates and rivets must bend 180 deg. flat without cracking; tubing to be submitted to a flanging test; rivets must have a tensile strength of 60,000 lb., a yield point of 40,000 lb., an elongation of 25 per cent in 2 in. and a reduction in area of 50 per cent. No physical tests are specified for castings, but provision is made for heat treatment and a porosity test under 150 lb. hydrostatic pressure.

The report is signed by F. M. Waring (chairman), engineer of tests, Pennsylvania; C. P. Van Gundy, engineer of tests, Baltimore & Ohio; Frank Zeleny, engineer of tests, Chicago, Burlington & Quincy; A. H. Fetters, general mechanical engineer, Union Pacific; H. G. Burnham, engineer of tests, Northern Pacific; J. C. Ramage, engineer of tests, Southern; J. H. Gibboney, chemist, Norfolk & Western; F. T. Quinlan, engineer of tests, New York, New Haven & Hartford; T. D. Sedwick, engineer of tests, Chicago, Rock Island & Pacific; A. G. Hoppe, engineer of tests, Chicago, Milwaukee, St. Paul & Pacific; H. W. Faus, engineer of tests, New York Central; H. D. Browne, engineer of tests, Chicago & North Western, and E. E. Chapman, engineer of tests, Atchison, Topeka & Santa Fe.

Discussion

F. M. Waring (Penna.): The committee, after the printing of this report, held a meeting and decided to make a change in the specifications for normalized and drawn carbon-steel forgings, Exhibit E. This change in detail has been submitted to the Secretary and the committee desires that the specifications when printed, carry the revision.

[The essential revisions referred to have been made in the above abstract of the report—Editor.]

The recommendations of the committee in the report were accepted.

A 1,500-lb. capacity gasoline tractor hauling two pairs of engine truck wheels from the erecting shop to the wheel shop

Report on Brakes and Brake Equipment

G. H. Wood
Chairman

Complaint has been made in numerous instances on account of dirt, etc., being blown on passengers on station platforms, resulting from the downward blast of quick-action exhaust port of the universal passenger-car brake equipment, when for any reason the brake pipe pressure is depleted. This condition can be corrected without interfering with brake operation by applying a 1¼-in. elbow to the exhaust port, directing it at a suitable angle toward the center of the car.

We understand that various railroads are following this practice and your committee suggests, in order that the situation may be completely covered, that the application of a street elbow to the quick action exhaust port of the universal valve, passenger car brake equipment, be made standard practice.

Location of Steam and Air Connections for Passenger Cars

Last year your committee prepared, at the request of the General Committee, a revision of the Manual of Standard and Recommended Practice, to provide for 2-in. steam-heat end valves, flexible metallic connections and hose couplings, since which time the question of proper location for the steam train line has been given consideration.

Due to the variety of present car end construction, the numerous types of steam-heat train-pipe end valves in use and the introduction of different types of metallic steam-heat hose connections, many difficulties have been encountered in finding a suitable location. Much data have been collected in connection with the subject and we hope to be able to submit at your next meeting, complete dimensions and formula for your approval.

The piping for air-brake equipment on freight cars, in general use, is single-weight pipe, and what is known as commercial pipe fittings. A question has arisen in connection with efforts being made to bring about a reduction in the number of failures of air-brake piping on freight cars, and a reduction in the normal leakage from the brake system.

It is our recommendation that the piping for air-brake equipment for freight cars be extra heavy, except nipples at angle cocks, which should be standard weight.

Following the action of the Committee on Locomotive Design and Construction, which we understand has developed plans for locomotive pipe fittings, this committee will submit for your approval a recommendation with reference to pipe fittings for freight cars, in order that the maximum interchangeability of fittings may be provided for.

Prices New for Reclaimed Brake Beams

The General Committee recently considered a report of the Joint Committee on Reclamation of Purchases and Stores and referred to this committee a recommendation to the effect that prices new be charged for brake beams where all parts with the exception of compression members are new; also that a rule be adopted requiring that proof tests be made on all second hand or repaired brake beams.

The present A. R. A. rules provide a charge of 75 per cent of new values for all repaired brake beams. This price is made up for an average amount of work to be done upon defective beams and we feel that there should not be more than one charge for repaired beams, and that the present price will compensate for the average work done on such beams.

In regard to the recommendation that an A. R. A. rule require proof tests on all second-hand or repaired beams, this committee feels that such tests would be desirable and approves this recommendation, with a suggestion that repaired brake beams applied to foreign cars must have a proof test in order to justify billing for them. We also suggest to the Arbitration Committee that there should be some identification of repaired beams having passed the proof test.

We believe it is common practice, at least on many railroads, to repair brake beams at a large number of points, and to carry out the above recommendation properly, it would probably be necessary to concentrate the work at some central point, in order to justify the use of a brake-beam testing machine for giving all brake beams a proof test; otherwise confusion may result on account of repaired beams being applied to foreign cars without ample facilities to provide for proper billng for such work.

Auxiliary Reservoir Release Valve

Within the past two years there has been considerable agitation with respect to providing an auxiliary-reservoir release valve which would be an improvement over the present standard.

Numerous patented devices have been devised to accomplish the above result, but in many cases they involve considerable initial cost and maintenance; they embrace automatic features of blocking the release valve open when the brakes are applied, if the release-valve rod is pulled to its open position, and automatically to close the release valve after the brake releases.

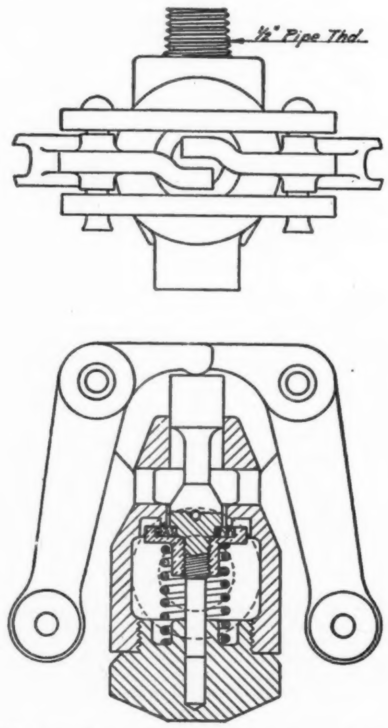


Fig. 1—Improved auxiliary reservoir release valve

Some of them do not permit a partial bleeding of air pressure from the auxiliary reservoir; others depend upon a jar from the train to effect the automatic closing feature. These devices have been designed to reduce the time of depleting the brake system of pressure upon the arrival of trains at terminals preparatory to the usual switching operations and to overcome complaints arising due to the trainmen blocking the release valves open with sticks, stones, etc. or bending the release rods to hold the valves open on account of the time required with the present standard valve to deplete the auxiliary reservoir of all pressure.

Complaints are received of reports being rendered by federal inspectors upon finding release-valve rods bent, so as to foul the release valve and prevent its proper closing. It has also been suggested that release rods be made of ½-n. material to prevent the bending of rods.

In order that the situation might be taken care of without using complicated devices to supplant those now used, your committee has given the subject consideration with a view of

suggesting a modification of the present standard value which will provide for depleting the pressure from the auxiliary reservoir in the minimum practicable time. Accordingly investigations were made and finally a meeting was held by a sub-committee of this committee at the Westinghouse Air Brake Company's plant to witness a test of two types of improved release valves submitted by the air brake company. Later, tests of these new valves on a 100-car train on the Hocking Valley were made, compared with the present standard valves with which the cars were originally equipped. Fifty-four minutes time was consumed in depleting the brake system of pressure so that the train was in condition to be switched. The standard valves were then removed and the modified valves applied, after which, the same man depleted the brake system of pressure in 22 minutes.

All members of the brake committee were present during these latter tests and from the result thereof, feel that the improved release valve will reduce the time of depleting the brake system of pressure and place the cars in position for switching in approximately one-third the time now necessary with the present standard valve. We are also of the opinion that no detrimental effects will arise from bleeding the auxiliary reservoirs in the short time needed in the way of causing other brakes to set on moving trains when desirable to release one or two so-called "stuck brakes." The capacity of this improved release valve is such that an air pressure of 70 lb. may be depleted from a standard freight brake auxiliary reservoir in approximately three seconds time.

The results obtained with the valve submitted by the Westinghouse company, and which is shown in Fig. 1, simplifies modifications necessary to bring about the improvement sought, and we, therefore, recommend that this valve be adopted as recommended practice for general use.

The report is signed by G. H. Wood (chairman), supervisor of air brakes, Atchison, Topeka & Santa Fe; T. L. Burton, air brake engineer, New York Central; B. P. Flory, superintendent motive power, New York, Ontario & Western; J. M. Henry, assistant chief motive power, Pennsylvania; M. A. Kinney, superintendent motive power, Hocking Valley; H. A. Clark, general air brake inspector, Minneapolis, St. Paul & Sault Ste. Marie; W. H. Clegg, chief inspector air brakes and car heating equipment, Canadian National; Mark Purcell, general air brake inspector, Northern Pacific; R. B. Rasbridge, superintendent car department, Philadelphia & Reading; G. E. Terwilliger, supervisor of auxiliary equipment, New York, New Haven & Hartford, and M. J. O'Neill, general mechanical superintendent, Denver & Rio Grande Western.

Discussion

E. Von Bergen (Illinois Central): The vertical type of auxiliary reservoir release valve has been the common standard ever since the inception of release valves. This valve has been fairly reliable in its operation, comparatively simple in construction and economical in maintenance. The horizontal release valve has been available for the past 20 years or more, and evidently there has been no outstanding advantage in it over the vertical type which seems to justify substituting one for the other. If a vertical type valve is available which is equally as simple in construction, as dependable in operation, and as economical in maintenance as the present standard valve, and which will effect the depletion of the auxiliary reservoir pressure in the desired time, such a valve is equally as desirable as a horizontal type. Ordinarily, after a release valve has been in service for a considerable time, difficulty would be experienced in removing the cap nut for the purpose of applying new stems or new rubber seats to extend the service. Usually, inspectors and repairmen in the train yards are not provided with a kit of tools suitable for dismantling release valves attached to auxiliary reservoirs, and an attempt to remove the cap nuts from the horizontal valve attached to reservoirs would, in many cases, result in breaking the stud connection. It would be more economical to remove the valve entirely and substitute a valve known to be in good operating condition.

A vertical valve which will meet the requirements specified, and which is substantially the same as the present standard release valve, is available at a cost approximately that of the present valve. At any rate, this cost would not be as great as that of the horizontal type of valve recommended.

I offer an amendment to the recommendation on release valves that either a vertical or horizontal release valve of such capacity that an air pressure of 70 lb. may be depleted from a standard freight auxiliary reservoir in approximately three seconds be accepted as recommended practice leaving it optional as to which type may be used.

Mark Purcell (Northern Pacific): Lowering the pressure down too fast must be considered and also the feature of the valve shutting off automatically, at a time indicated, before such excessive depletion has taken place. The idea of the committee was to have a valve that would fit on old cars, in fact all types of cars in use today, without having to make changes in the location. If a valve was made large enough to bring about the quicker reduction in pressure, it would be too large to put on cars of present construction and location of the auxiliary reservoirs. Therefore, careful consideration should be given to that feature, before deciding upon which depletion cock should be used—the one proposed by the committee, or the one proposed in the amendment by Mr. Von Bergen.

G. H. Wood (A. T. & S. F.): Mr. Purcell's remarks are directed to the vertical type, which was used during the test and of the two, the horizontal type was thought to be the best. It is my understanding from Mr. Von Bergen's remarks that a vertical valve is available which can be substituted for the present valve without any changes, and if that is a fact, there might be some merit in the suggestion. The committee did not have any valves available, other than the two types submitted by the air-brake companies.

The two valves were designed at the request of our sub-committee, and the air brake companies made no suggestions as to what valves should be accepted, except that they proposed one valve for two positions; one the present time position, and one the increased time which the committee desired.

Mr. Von Bergen: As Mr. Wood explains, the object is to have a release valve that will deplete the pressure to zero in two seconds, and the only object in offering this amendment is to allow the railroads the option of using either the vertical type or the horizontal type.

Mr. Demarest: In the operation of release valves, I take it there are two purposes. We have trainmen using it, and inspectors using it. The trainmen use it simply to release a stuck brake. The transportation yardmen use it to deplete the reservoir, to release a sticking brake, I don't see the reason for completely depleting the auxiliary reservoir. Has the committee thought of a release valve that would automatically retain the air remaining in the auxiliary reservoir after the brake is released? On many occasions this will save time, because instead of having to hold onto the release handle until the operation of the brake release is finished the inspector can pull on the handle and go to the next car.

Mr. Wood: We have been besieged for the last two or three years with automatic devices for depleting the auxiliary reservoir. One of these contemplated reducing it during the period the brake is released, which must practically empty the reservoir. Now with the

type of valve that we propose, it is only necessary to pull the handle and let go of it: that will bring the auxiliary pressure down 6 or 7 lb. The balance of the pressure is retained in the auxiliary reservoir.

The brakeman, when he has to run alongside the car, particularly at night, to get a brake off, doesn't want to let the brake go and stick. He wants to be sure he gets it off, and he has found many instances where he has failed to get it off by touching the handle, so he has gotten into the habit of opening the valve and hanging on until the pressure is all gone. With that valve, he releases the brake simply by touching the valve, and that is all. The high-pressure valve and one that locks itself open both have disadvantages. The locking device that will deplete the auxiliary reservoir before the brake piston is returned to a released position might give trouble; the man could stand alongside the train and pull the release handle, and empty the whole train, where it is necessary to hang onto the release rod. As soon as he lets go of the handle with this valve, it starts charging and by the time he has gotten hold of the third or fourth one, the first one is charging again, and after he goes four or five cars back in the train, the second or third reservoirs are the only ones that he can keep low, because the brake pipe keeps charging behind him all the time. You can not do that with any locking device that has been submitted to the committee so far.

Chairman Smart: We would like to hear more from the chairman of this committee as to how he considers this amendment—as I understand the amendment, it was a valve of horizontal or perpendicular position. Do you want to comment on the amendment, whether it is permissible to use the valve in the horizontal or perpendicular position?

Mr. Wood: As to Mr. Von Bergen's amendment, nearly all of the cars in the country are now equipped with the vertical valves. As far as I am personally concerned I would be willing to accept the amendment.

Vice-Chairman Ayers: Will Mr. Von Bergen tell us the advantages gained by the vertical valve, compared with the horizontal, assuming that the two have the same outlet force?

Mr. Von Bergen: From our road's standpoint, the idea is that the vertical valve is considerably cheaper than the horizontal, and will do the same work. We would like to have the option of using it.

M. A. Kinney (Hocking Valley): If we adopt the amendment proposed here, we will get into our hands a different type of release valve and as a member of the committee, I feel, from observations, tests and experiments that have been made, that we are probably on the right track.

Mr. Von Bergen: It is true that the internal parts of these two valves recommended by the committee are slightly different from the one that I suggest, but if we desire to have them interchangeable, they can be made so. It is just a question of whether they operate in an upright or in a horizontal position.

Mr. Kinney: If the horizontal valve is adopted, we will have two types of valves, but that will not exist very long. Any transportation officer in the railroad world who finds out that a train can be bled for switching in 20 minutes, where it now requires one hour, will get after all of us to change our valves, and we will soon have the quick-action valve.

A. G. Trumbull (Erie): If the chairman admits that the vertical valve will cost less, and that it will accomplish the same result as the horizontal valve, why did the committee recommend the horizontal valve?

Mr. Wood: The chairman is simply standing with the recommendations of the committee made in his absence. Personally, it doesn't make any difference to me which valve we use. The main thing is to accomplish the result we are after, as economically as we can.

Vice-Chairman Ayers: There is a great advantage in the increase in the size of the valve as recommended by the committee. In the past we have usually taken what the air-brakes companies gave us in matters of this kind and I don't recall there has been a great deal of designing on the part of the railroad companies. If we attempt to design the valve, we will put off its adoption too long. The cost doesn't amount to much, anyhow, in comparison with the benefits we get from it, and in time the air-brake companies, working with the railroads, will find out what is the best, and then there should be only one design, instead of two. I can not see how any slight decrease in the cost would warrant carrying more than one design, unless there is some reason for two that has not been developed. I very strongly recommend that the size of the opening be described, and let the air brake company develop the details.

On motion, the report of the committee was accepted as submitted.

Report of Committee on Wheels

A. Knapp
Chairman

The specification for cast-iron wheels, presented in the 1928 report, with the section added in reference to foundry practice, is being used quite generally by the railroads. A few changes are under consideration particularly in the foundry practice section, but it is the opinion of your committee that the specification should be continued in its present form for another year.

It is generally observed that the single-plate wheels are quite superior to the former type of wheels in their resistance to the thermal test and it is believed that this quality will result in a general reduction in the failures due to heating as a result of brake action.

The committee has received a few suggestions in connection with the desirability of increased drop-test requirements but investigations show that practically all of the manufacturers are testing the wheels selected for drop test to destruction for their own information and permanent records are kept which are open for inspection of any railroad representative at any time. For this reason the committee feels that it is not necessary nor advisable to increase this requirement at present. On the contrary, it might have a detrimental effect on the progress the manufacturers are making in the manufacture of the single-plate wheel.

When the new specification was presented to the association, it was not considered necessary to include a drawing illustrating the form and location of the lugs for indicating tape sizes, as this is well protected in Sections 5 and 10 which require that five small lugs 3/8 in. in diameter and 3/8 in. high be cast on the back of the plate under the rim. A drawing is included in the report this year to indicate a suggested location of the tape lugs and other marking required for identification of cast-iron wheels for trial prior to next revision of the specification (see Fig. 1).

The design of hub, plate, rim and flange as recommended in the 1927 report and proposed for adoption as standard in the 1928 report, is working out very satisfactorily. The single-plate design of wheel has been accepted by practically all of the members of the association and all of the wheel foundries are progressing rapidly in a complete change to this design of wheel. The information presented by the manufacturers' association indicates practically 1,000,000 of the single plate wheels in service and they so far show a decided resistance to thermal stresses, only a very small number having been reported as developing a crack in the plates to date. In each case the wheels which developed cracks in plates were among those first produced and apparently the heating conditions which led to the development of the cracks were extremely severe.

The manufacturers report some difficulty due to circumferential shrinkage cracks which occur in the hubs of some of the single-plate wheels and some of the purchasers object to the presence of these circumferential cracks around the bore of the hub. No report of a wheel failure which could be attributed to the presence of a circumferential crack in the bore has ever been received. Most of the large users, after thorough investigation, have consented to acceptance of drawn hub wheels within certain limits. This subject will be given further study during the coming year and, in the meantime, information is desired from the members of the association on this subject. A clause which is now under consideration for recommendation next year as an addition to the specification reads as follows:

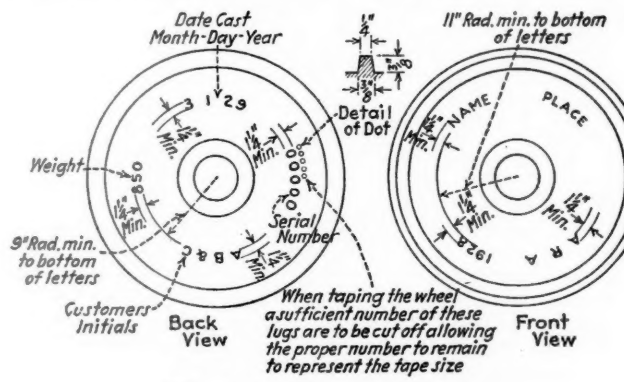


Fig. 1—Location of markings

Drawn hubs will be accepted in a reasonable percentage of the total wheels presented for inspection, when the draw is open not more than 1/16 in. before the hub is machined and is not more than 1/32 in. wide when finish bored.

The committee recommended seven different types of engine-truck wheels in the 1928 report, suggesting that it be referred to the locomotive committee for further consideration and referring to a study of various types of wheels in order that something might be done towards the standardization of wheels for electric locomotives and motor cars. The Wrought Steel Manufacturers' technical committee has cooperated with your committee and also with the equipment builders in an extensive study of this subject. Investigation of this subject shows the desirability of adopting some standard form of wheel for use in this important service. The committee feels it is necessary to establish a set of standards to aid the equipment builders in the selection of a safe form of wheel for the various types of electrical equipment and the study of this important subject continued for another year.

Wheel Mounting Gages

The gage submitted to the Association for mounting reinforced-flanged cast-iron wheels, Fig. 118, also the gage submitted for mounting wrought-steel wheel, Fig. 119, in the 1927 report and subsequently adopted by the association as recommended practice, seem to meet the requirements in all respects. The experience with the wrought-steel wheel mounting gage indicates that it is satisfactory in every respect with the possible exception that, when two minimum-flanged wrought-steel wheels are mounted in accordance with instructions contained in paragraphs 247-250 of the A. R. A. Manual, the back to

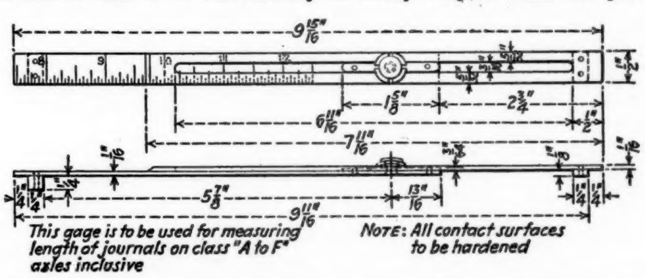


Fig. 2—Gage for measuring the length of journals on car and tender axles as per paragraph 208 of the A.R.A. wheel and axle manual

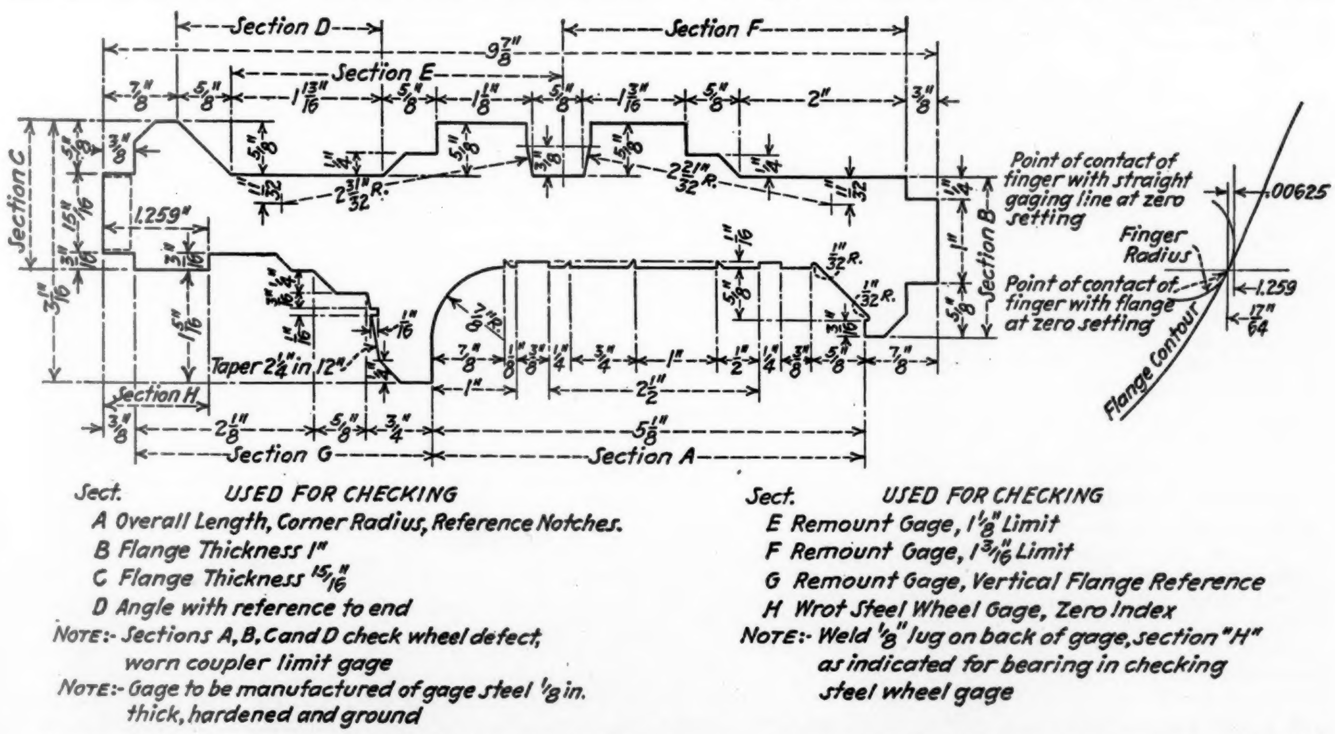


Fig. 3—Master gage for checking A. R. A. standard wheel d efect and worn-coupler limit, remount and wrought steel wheel (zero index) gages

back distance may slightly exceed 4 ft. 5⅜ in. Inasmuch as the maximum spacing between two new minimum flanged wheels will not exceed 4 ft. 5 7/16 in. your committee does not consider this of particular importance but it is suggested that, prior to application to steam-locomotive service, each pair of wheels should be checked with a 4 ft. 5⅜ in. pin gage to avoid application of any wheels exceeding the I. C. C. requirement of 4 ft. 5⅜ in. maximum back to back. The wheel-mounting and check gage for mounting reinforced-flanged cast-iron wheels insures proper spacing in practically every case with the possible exception that, when a reinforced flange wheel is mated with a wheel of the former standard flanged type, the wheels will be mounted off center in relation to the axle if the former standard-flanged wheel is mounted first. Inasmuch as it is permissible to mate wheels with the two types of flanges under interchange Rules 25 and 70, the reinforced-flanged wheel should be mounted first to insure exact centering of the wheels on the axle.

Journal Length Gage

The committee's report for 1926 called attention to the desirability of a gage for insuring proper measurement of the length of worn journals. Since that time a number of gages have been presented for consideration and one presented by a large eastern railroad, after thorough investigation as to its adaptability and any possible patent infringements, has been selected as the most practical for the purpose. The committee would like to present this gage (see Fig. 2), for adoption as recommended practice.

This gage, or any approved equivalent, should be used as directed in Par. 208 to obtain measurements as illustrated in Fig. 113 of the A. R. A. Wheel and Axle Manual. Attention is directed in this connection to Interpretation (4) of Interchange Rule 9 to insure that the measurements be considered in sixteenths. For example, if the gage reads 9⅜ in. plus, the reading is to be reported as 9⅜ in. until the gage actually reaches a length of 9 7/16 in., it being understood that this interpretation must not conflict with the limits prescribed for determining scrapping limits.

At the present time a large number of axles are scrapped because of journal length; that is, they are scrapped for length before the journal diameter is reduced to minimum allowed by the rules. If the limits for journal length were increased a longer life would be secured for the axles. As the wheel committee views it there would be no harmful results developed from an increase in the journal length limits. This is a suggestion which should be given consideration by the Arbitration and Car Construction Committees.

Re-conditioning of Axles

A report has been received from one of the large western roads about the number of axles which are found in service with collars built to ⅞ in. to 1 in. thickness through the addition of metal welded to the inside fillet of the journal collar to restore worn collars and reduce length of journal so that it will come within condemning limits. This is bad shop practice and may lead to trouble in service particularly when new brasses are applied. The committee believes this subject is of sufficient importance to warrant the attention of the Arbitration Committee and a possible addition to the interchange rules to prohibit such practice, which might be accomplished by adding at the end of Rule 85—

or collars of thickness greater than those shown in Column H for dimensions new in table of axle sizes on Page 110.

Wheel and Axle Manual

The Wheel and Axle Manual, which was submitted as recommended practice at the 1928 convention, is reported by your secretary as in considerable demand. For the first issue 15,000 copies were printed and it has been necessary to order an additional lot of 10,000 copies. The committee has a number of subjects under consideration which will be presented within the next year or so for addition to the manual to cover shop practice as it concerns driving and trailing wheel, tires, driving axles and similar subjects. The committee has been favored with a few suggestions from members of the association and would appreciate further recommendations.

Some railroads, in their reports of wheel failures, are employing the figure numbers of the illustrations of the various types of wrought-steel and chilled-iron wheel defects as shown in the A. R. A. manual. This system is commended to the association as it is valuable not only as a means for accurate reports but it also encourages frequent reference to the manual on the part of those in direct contact with wheel and axle work.

The committee would like to take this opportunity to urge the distribution of the manual to, and its use by, every one concerned with wheel or axle work in order to conserve material, bring about a higher standard of workmanship in shops, standardize reports of wheel and axle defects, promote safety and economy in operation and aid in development of a better quality of material to meet the increasing demands of service.

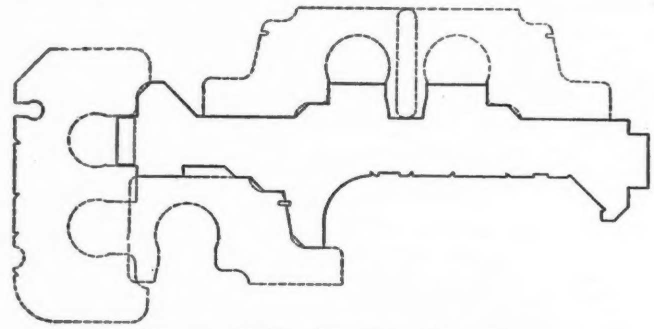


Fig. 4—Application of master gage

Inasmuch as the interchange rules have been cross-referenced with the Wheel and Axle Manual and now refer directly to it in connection with rules governing wheel defects, the manual is in reality a part of the interchange rules and the proper application of these rules by inspectors and others necessitates reference to the manual. Therefore, all employees involved in the use of the interchange rules, so far as wheel defects are concerned, should have a copy of the manual available.

Master Gages for Checking New and Worn Standard Gages

The committee would like to submit a drawing of a master gage for checking new gages (see Fig. 3). It was designed by one of the A. R. A. inspectors and has been carefully checked by the wheel committee. Some additions have been made so that the master gage can be used to check the wheel-defect and worn-coupler limit gage, both remount gages and the important feature of the A. R. A. standard steel-wheel gage, namely, the distance between the contact point of the finger and the bearing face which applies to the back of the wheel rim. Figs. 4 and 5 indicate the application of the master gage for checking all of the gages which it is designed to check.

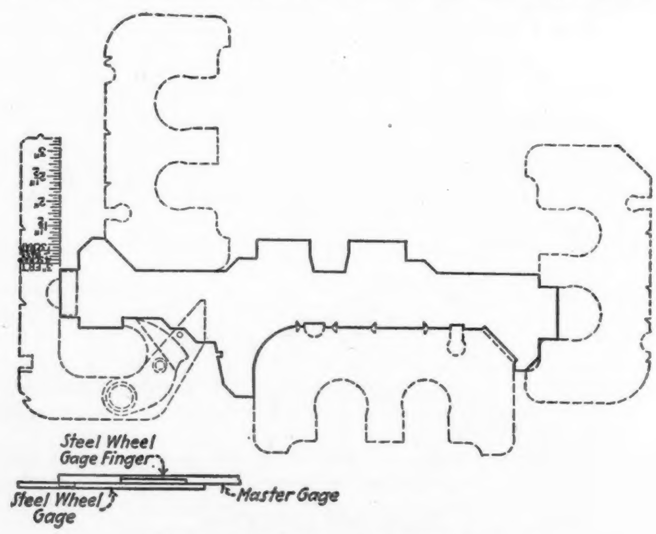


Fig. 5—Application of master gage

Attention is again called to the importance of checking all

new standard gages as received from the gage manufacturers and before they are distributed for use in wheel and axle work as frequently incorrect gages have been distributed for use and have led to considerable disagreement and the loss of a large amount of material because of inaccurate dimensions.

Removal of Wheels from Refrigerator Cars Before Condemning

This important subject was referred to your committee as a result of instructions issued to some inspectors which nullified the A. R. A. rules establishing the limits at which wheels shall be removed from service. The instructions require the removal of all wheels which, in the opinion of the inspectors, are liable to reach their condemning limits during a through trip under cars scheduled for long trips in refrigerator and similar freight car service.

This subject has been assigned to a special committee and extensive tests are under way to establish the approximate wear of chilled-iron and wrought-steel wheels for a given car mileage.

There appears to be a misunderstanding among inspectors as to how measurable defect limits are set. Some have an idea that no margin of safety is provided, whereas the fact of the matter is that the committees, in establishing these limits, have always provided sufficient allowance to insure that the car may be handled to its destination after defect limits have been reached. It should be understood that this applies only to measurable defects and does not apply to such defects as cracked plate, seam in the throat, loose wheels, etc.

The committee recommended in the 1928 report a gage for use in measuring high flange and tread worn hollow in locomotive tires. No other gages have been submitted which will cover this requirement as accurately as the gage referred to and it is now in the hands of a special committee for further study to develop a method for measuring tire thickness and also for slight modification in the bearing face of the gage on the back rim face so that it will not interfere with Mansel retaining rings.

Relations with Wheel Manufacturers

The committee has met with representatives of the Wrought Steel Wheel Manufacturers' technical committee and of the Association of the Manufacturers of Chilled Car Wheels for the usual discussion of wheel subjects insofar as they refer to conditions of manufacture and specifications.

The subject of wrought steel and chilled iron wheel defects has also been discussed and your committee would like to express its appreciation for the cooperative spirit of both the wrought-steel and chilled-iron wheel makers for the aid they have rendered in connection with tests and experiments for developing better materials for railroad service and for the assistance they have been in connection with the studies of shop practices and service conditions in general.

The committee recommends submission to letter ballot of the following propositions which have been discussed in this report:

1—That the journal-length gage shown as Fig. 2 in the report be adopted as recommended practice of the Association.

2—That the master gage for checking standard gages of the A. R. A. for wheel defects, and shown as Fig. 3 in the report, be adopted as recommended practice of the Association.

The report is signed by A. Knapp (chairman), inspecting engineer, New York Central; C. T. Ripley, chief mechanical engineer, Atchison, Topeka & Santa Fe; O. C. Cromwell, assistant to chief motive power and equipment, Baltimore & Ohio; G. B. Koch, general foreman foundry, Pennsylvania; H. W. Coddington, engineer of tests, Norfolk & Western; J. Matthes, chief car inspector, Wabash; C. Petran, superintendent tools and machinery, Chicago, Milwaukee, St. Paul & Pacific, and F. R. Callahan, supervisor railroad repairs, Pullman Company.

Discussion

A. Knapp (N. Y. C.): The committee would appreciate any information from the members. For instance, my attention was directed this morning to the failure of a single plate wheel, due to a circumferential crack around the hub. It was new to me, and anything of that sort, if you will send a line to the secretary of the association, we will gladly appreciate, because it aids us considerably in our specifications.

A few changes have been made since this copy was printed. One-eighth inch radius has been inserted at four locations, to check the one-eighth radii on our wheels mounted, and where a 45-deg. angle is shown, it will be so indicated in the reprint. There are one or two additional notes which have been added, although of minor importance.

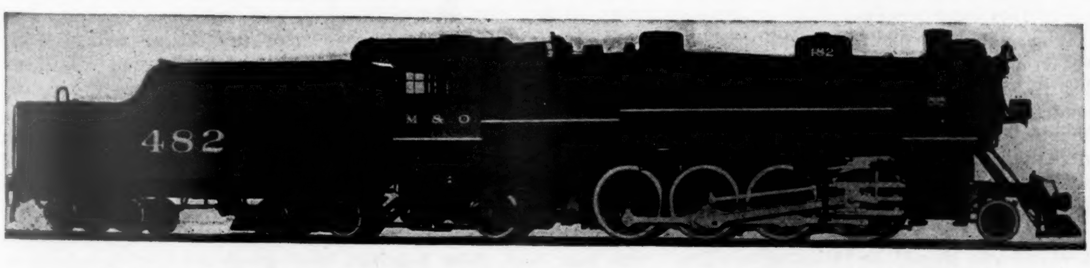
Chairman Smart: Your chairman extends the privilege of the floor to the cast iron wheel manufacturers, and the wrought steel wheel manufacturers.

F. W. Brazier: (N. Y. C.): I move that the committee's report be accepted, and that thanks be given to the committee for their able work. I know of nothing that we have had in our association that has attracted as much attention as the reports for the last few years of the Wheel Committee.

C. T. Ripley (A. T. & S. F.): A lot of good axles are being thrown away because of our rule covering journal length. I can not see, myself, why an axle should be scrapped for journal length. What is the real danger involved when it is over length? More length is desirable, rather than not. The real danger is in the wear upon the journal diameter. I hope that the committee will give this careful study, and see if there is any detriment in increasing the journal length. In that way we can save a great deal of money. Many railroads are scrapping axles, instead of trying to save them merely because they are a 1/64-in. off.

All of us have systems of our own for designating and reporting certain defects. The trouble is the inspectors do not get these defects correctly. This is an injustice to the manufacturer, because the replacement of wheels removed on foreign roads is made on the basis of the description of the defect in the billing. Almost always they call a brake burned wheel a seamy wheel. The seamy wheel is replaceable; the brake burned wheel is not. We should all use some discretion. The proper method is to refer to the wheel and axle manual, and that will certainly give the inspector a definite idea as to what the defect is. This would simplify billing, as the bill would not describe the defect at all, but give a standard number. I hope that if necessary some method of marking defects may be developed.

Mr. Brazier's motion, that the report be accepted with the thanks of the Division, was adopted.



Tr. force, 54,800 lb.
Wt., engine, 295,500 lb.
Wt., drivers, 224,500 lb.
Cyls., 26 in. by 30 in.
Drivers, 63 in.
Pressure, 200 lb.
Evap. h.s., 3,771 sq. ft.
Superheater, 933 sq. ft.
Grate, 66.7 sq. ft.

Mobile & Ohio 2-8-2 type locomotive built by the American Locomotive Company

Lubrication of Cars and Locomotives

G. W. Ditmore
Chairman

Continuing the study commenced last year, the committee made an extensive investigation of lubrication practices in various parts of the country, and found that a remarkable diversity of practices and methods are in use.

In the report of the sub-committee on locomotives some very valuable information has been collected and is presented herewith.

Your sub-committee appointed at meeting November 22, 1928, to make a study of the latest developments in locomotive lubrication, has completed this work, and reports as follows:

Roads and Shops Visited

Union Pacific—Laramie, Wyo., and Cheyenne; Denver, Colo., and Kansas City.
Denver & Rio Grande Western—Denver, Colo.
Denver & Salt Lake—Denver, Colo.
Chicago, Rock Island & Pacific—Kansas City.
Missouri-Kansas-Texas—Parsons, Kan.
Grand Trunk Western—Battle Creek, Mich.
Illinois Central—Memphis, Tenn.
Chesapeake & Ohio—Huntington, Ind., and Peru.
Delaware & Hudson—Oneonta, N. Y.

Driving Journal Lubrication

Successful driving journal lubrication, the object of which is to eliminate hot bearings and produce the maximum economy in the use of lubricants, depends equally as much on the best method of machining and fitting driving journal bearings, as it does on the use of the correct lubricant and proper practices in handling and applying it.

Therefore, the committee in this report, sets forth its recommendations as to machining and fitting of bearings, and finishing of journals.

Finishing Driving Journal Bearings—On the various properties visited, the Committee found no two methods alike, the practice on all roads differing as to clearances, grooving and finishing. It appears to the committee, in view of the fact that journals and brasses that have been in service for many thousands of miles attain a smooth polished surface and run at lower temperature than new journals and bearings, that it is self-evident that a smooth polished surface on new journals and bearings, will deliver better results than surfaces that are more or less rough. On one of the properties visited, the committee observed the use of a burnishing tool in a vertical boring mill for the final finish on the bearing surface. After the cutting of grooves and cavities and boring was completed, the cutting tool was removed. and the burnishing tool shown in Fig. 1 was placed in the tool post. After this tool had moved over the entire surface of the bearing, it left a very smooth burnished finish. We found with this method that heavy passenger locomotives after receiving heavy repairs were operated only a distance of 50 miles as a helper, and then sent out on long passenger runs of approximately 600 miles, without trouble. The committee unhesitatingly endorses this method, or any method that will produce equal results, for finishing the bearing surfaces on driving brasses.

Fitting of Driving Brasses into Driving Boxes—One of the most prolific sources of hot driving journals on heavy high-speed locomotives is the closing in of driving brasses on journals when they reach a temperature somewhat above normal running temperature. It is not infrequently found that the brass is shrunken away from the box at the fit at the lower ends, to the extent that a .012-in. feeler can be inserted between brass and box. On one property visited, the committe observed the fitting of driving brasses in boxes as shown on Fig. 2. It will be noted that the angularity of the brass at the lower ends is such that it slopes 3/8 in.; therefore, when accurately fitted in the box the brass is locked and it is impossible for the brass to shrink away from the box. The committee believes this method is excellent and should be followed to eliminate this particular source of trouble.

Pressures Used for Pressing Brass into Box—It is the opinion of the committee that the practice heretofore followed on many roads of using 40 tons or more pressure to press brasses into driving boxes is another source of causing the brasses to close in on the journals as the sides of the box are expanded when brass is forced in with this pressure. The committee recommends a minimum of 10 tons and a maximum of 20 tons, as it has been proved on roads following this practice that this pressure is ample to hold the brass solidly in the box, and a less number of loose brasses in boxes actually occur than when forced in with the higher pressures.

Driving-Brass Boring Clearances—A prolific source of hot driving journals is the attempt to make too close a fit of the brass on the journal when newly applied. Pyrometer tests have shown on heavy high-speed passenger locomotives, the journal-bearing running temperature frequently reaches 325 degrees F., and at this temperature expansion of the brass is approximately .003-in per in. of journal diameter. Where a close fit of the brass on a journal is made in the shop, the

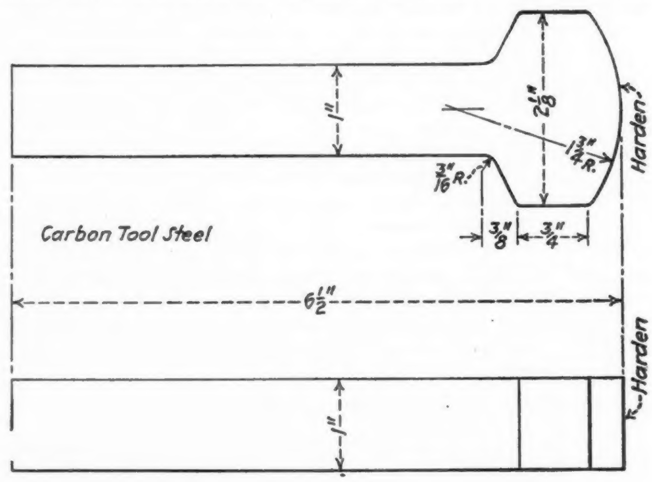


Fig. 1—Tool for burnishing bearing faces on driving brasses in boring mills

brass must pinch the journal when running temperature is reached, on account of the fact that expansion of the cast iron or steel box is negligible, as compared with the expansion of the brass. Therefore, as the box will not permit the brass to expand outwardly, it must expand inwardly, and thus aggravate the running temperature. This expansion inwardly on main journals is somewhat offset by the excessive thrust of the main rod. The Committee recommends that main journal bearings, be bored larger than the journal .002-in. per in. of journal diameter, and on other than main journals .003-in. per in. of journal diameter.

Grease Cavities and Grooves in Driving Journal Bearings—The committee in their studies on the various properties, found different methods of grease grooving on every property visited. It is the opinion of the committee that the application of numerous grease cavities and grooves to driving brasses has been carried to excess, and that more harm than good has been done on account of cutting away excessive amounts of bearing area. On one of the properties visited, on which the standard practice was to apply two longitudinal grease cavities, 3/4 in. wide and 3/8 in. deep, two babbitt strips 1 in. wide and 3/8 in. deep, two cross grooves 3/8 in. wide, 1/4 in. deep and lead grooves from the rising side of the brass 3/8 in. wide by 1/4 in. deep spaced 1 1/4 in. apart, it was decided to apply one-half of the driving brasses on a heavy Mountain type locomotive while in the shop, eliminating the babbitt strips and all cavities and grooves, except one grease cavity on the back side of the brass, and the lead grooves leading to it. This locomotive had been operating in service on very fast passenger runs for approximately one year, and these bearings have given no trouble whatever, the performance of these bearings with the reduced number

of grease grooves and cavities being just as good as those with numerous grooves and cavities. This road is now preparing to equip an engine of similar type in a similar manner, except that the lead grooves will also be eliminated. It is the opinion of the committee that numerous cavities and grooves are a waste of labor and accomplish nothing, and that one grease cavity on the back side of the bearing is ample, the only necessity for this cavity being to assist in starting the feed of journal compound when the locomotive begins its trip.

Champfer at Lower Edges of Driving Brasses—With grease lubrication it is very important that the grease shall readily enter between bearing and journal; therefore, a champfer should be provided at the lower edge of the bearing at the rising side of the journal as shown in Fig. 2. In order to accomplish this without extending too far above the center line of the journal, thus producing a pound, the committee recommends that the lower edges of the driving brass next to the journal extend ⅜ in. below the center line of the journal as shown in Fig. 2.

Finishing Driving Journals—It is the opinion of the committee that the smoothest possible surface should be provided on driving journals when turned. On many roads, the surface is rolled after the final cut is taken. It has been brought to the attention of the committee that on one property not visited by the committee, driving journals are ground when

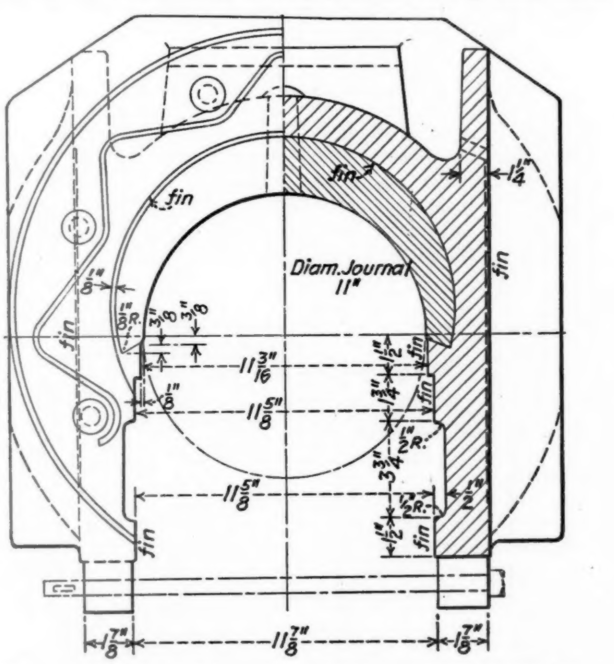


Fig. 2—Fitting driving brasses into boxes—Champfer on driving brasses

new journals are applied and the committee recommends this process.

Lubrication of Driving Journals—On the properties visited, the committee found excellent practices being followed in the application of journal compound to grease cellars. Grease presses with forming plates of proper dimensions were used to press the grease into cakes of proper shape. This is of utmost importance for successful lubrication. The practice followed by some roads in the past of pulling down the follower plate in the cellar and ramming grease into the cellar between follower plate and perforated plate, will always sooner or later result in serious trouble, and such practice should be absolutely prohibited. On some of the properties visited, the perforated plate, after being cleaned, was pressed on the grease cake, and on others the perforated plate was placed in the bottom of the shape and the grease pressed on it. On others, the grease cake was first shaped and a perforated plate fitted to the journal, then fitted to the grease cake by hand, and a light film of grease spread over the top. If a sufficient number of forms are provided so that perforated plate will be a good fit on the journal when it is pressed on the grease cake, this practice appears to work out successfully. Unless sufficient forms are provided however, the perforated plate should be fitted to the journal or a mandrel of the same dimensions, then fitted to the grease cake without distortion.

Perforated Plates and Follower Plates—The standard diameter of perforations in the perforated plates that are in common use has for many years been 3/16 in., and the tension of the follower-plate springs when compressed to 1-in. height, has for the lighter power been 50 lb. and for heavy power 100 lb. With the advent of the modern heavy high-speed power, it was found that the former type of journal compound, commonly referred to as "caustic grease," rendered a great deal of trouble with encrustation on top of the grease cake after being in service in the cellar a short time. The various oil companies then brought out what is known as "dehydrated grease," and this is now almost universally used. With the advent of the dehydrated grease, it was found on one of the properties visited that, although the encrustation was entirely eliminated, a new trouble developed. The grease fed through the perforated plate so rapidly that it would fall out the ends of the cellar in the shape of heavy ribbons. It would also pass between the journal and the bearing so rapidly that it would pass down the falling side of the journal and rapidly built up between the perforated plate and the side of the cellar. As the grease is of a somewhat sticky nature, this would prevent the perforated plate from moving freely in the cellar, and when forced down in the cellar for any reason enroute, it would stick away from the journal from ⅛ in. to ¼ in. With the flow of the grease thus interrupted, a hot journal would be developed. The excessive heat would then cause the grease to melt which released the perforated plate, and it would again come in contact with the journal. Then upon arrival at terminal those making the inspection, would be at a loss to determine what caused the hot bearing. It required several months research to ascertain definitely just what was happening. A check of the tensions of the follower springs at 1-in. height also developed quite a variation in those tensions, some of them running as high as 158lb. This heavy tension also caused the grease cake to spread laterally and stick in the cellar. A long series of tests was conducted on this property under the personal supervision of two assistant general lubrication engineers, with perforated plates having perforations of various diameters and various spacings, and with follower plates with springs of various tensions, and it was proved conclusively that perforated plates with perforations ⅛ in. diameter, spaced 7/16 in. from center to center, instead of perforation 3/16 in. diameter and follower plates with springs having not less than 35 or more than 40 lb. tension when compressed to 1 in. height, eliminated the overfeeding of grease and the sticking of perforated plates and grease cakes in cellars almost entirely, and also reduced the consumption of grease by one-half. The committee recommends a trial of this arrangement on any road confronted with the above troubles.

Narrow Grease Cellars—On several of the properties visited, a new type of grease cellar had been tried out and on two of the roads adopted as standard. Two roads had experienced trouble with this type of cellar and had abandoned its use. One of the roads had not yet adopted it standard, but had ten Mountain type locomotives equipped and operating successfully. On the two roads which had adopted it as standard, it had proved entirely successful and according to their records had effected an economy. Where this type of cellar is used, it is equally as important that the perforated plate be a proper fit in the cellar and on the journal and be guarded against distortion, the same as with the perforated plate in common use. A development in this type of cellar since it was first introduced is a series of ¾-in. holes through the portion of the cellar that extends from the sides of the grease cake to the inner edge of the box. When cellars are applied, a plate of 1/16-in. iron is welded over the holes on the rising side of the journal over which the grease flows to the bearing, and as it passes out on the falling side, it is expelled through the ¾ in. holes. This arrangement was made to prevent the old grease from passing over the top of the perforated plate repeatedly and contaminating it. The labor of packing the cellar is simplified with this type, as the grease cakes are narrow, being

three and four inches wide, thus being very light and easily handled by the box packers.

Reclamation of Driving Journal Compound—When the old grease is removed from the cellars for repacking, it is carefully sliced out of the perforated plate and the outer edges trimmed off with a knife, and then the remaining portion may be again pressed into a cake and used with good success. A very interesting process of grease reclamation was observed on one of the properties visited. The dirty trimmings from grease cakes removed from locomotives were placed in a kettle and boiled, then allowed to cool; some of the dirt and foreign matter went to the bottom, and some rose to the top. This foreign matter was then cut off and the remaining grease pressed into cakes and used on switching locomotives. This reclaimed grease has been in use on switching locomotives for approximately one year with apparent satisfaction.

Floating Driving-Journal Bearings—On two of the properties visited, a study was made of floating driving-journal bearing showed 3/64 in. wear combined outside and in. Hub of 33,000 lb. tractive force equipped with combined floating bearing and hub liner on main journals, was inspected. These had been applied June 6, 1927, to 10½-in by 15-in. journals. Bearing was bored .009 in. larger than journal, and .025 in. smaller than the bore of the box. After 60,000 miles service, the bearing showed 3/64 in. wear combined outside and in. Hub plates showed no wear. Bearings were renewed only because journals were turned, as bearings had been applied to old journals. Lubrication is accomplished by the use of three grease cups welded on box inside of frame. These cups have a spring plunger, and are filled with journal compound after 1,500 to 2,000 miles. A grease groove 1¼ in. wide by 5/16 in. deep extends across the box from each cup. Staggered holes are drilled through the bearings, the same as ordinary practice with floating rod bushings. Neither of these two bearings has ever run hot. On another property visited where some of the heavy passenger locomotives are equipped with floating main driving bearings, the committee inspected bearing removed from Mountain type locomotive after 80,000 miles service. The total wear on this bearing was 1/32 in., practically all on the inside, as tool marks were still slightly visible on the outside. When applying these bearings, the box is fitted with an iron bushing keyed in place, and the floating brass bearing has staggered holes drilled through it similar to floating rod bushings. The bearing is bored to a slip fit on the journal and the outer finish is 1/64 in. smaller in diameter than the iron bushing in the box. The brass hub plate is pinned on the driving wheel. The box has two grease cavities equipped with fittings for the application of driving-journal compound. These floating bearings can be very quickly renewed without dropping the wheels. It is the opinion of the committee that both types of floating bearings inspected contain substantial merit and are entirely worthy of trial.

Various methods of hub lubrication were found by the committee on the various properties visited. Trials have been made on various roads where the pressure system of grease lubrication on valve gears, etc., is used, by welding a cover on the oil pocket to shoes and wedges and drilling a grease hole to the shoes and wedges and to the hub face from these pockets, but this proved unsuccessful as one bearing surface will rob the other.

Another plan is to cover the middle pocket on top of the box with a plate, drill from this pocket to the hub face and apply the same grease through a similar fitting as is used on the valve gear. This appears to give very good results.

Another method is to leave the top open on this pocket, fill the pocket with grease, and allow it to flow through a drilled hole to the face of the hub.

On one property visited, the hub plate on the driving wheel is made of iron with a brass plate on the box. Six grease cavities are cast in the iron hub plate on the wheel. A grease pocket and hole is drilled from the outer surface of the wheel center through the hub connecting with one of the grease pockets in the hub plate. A good grade of graphite grease with a 300-degree melting point is forced into the grease pocket with a pressure gun at terminals, and as the wheel revolves the grease spreads over the entire surface of the hub from pocket to pocket. Locomotives so equipped usually pass through the shops for heavy repairs the second time before the lateral wear is sufficient to require renewal of hub plates. It is the opinion of the committee that this is the most efficient method of hub lubrication observed.

Engine-Truck Journal Lubrication

From the studies made by the committee, it is our opinion that engine-truck journal lubrication is more greatly in need of improvement than any other feature on the locomotive. The engine-truck journal and cellar are very close to the road bed and in close contact with road dust, water and snow, all of which are arch enemies of lubrication. The usual method followed by all roads is the use of oily waste packed in the cellar and is practically the same method followed forty to fifty years ago. Some improvement has been made on the properties visited by eliminating the oil holes through the top of the brass and lining, and instead casting or drilling the oil holes around the side of the shell so that oil poured on top of the bearing will be fed to the waste packing and the pumping of oil out of the packing and through the top of the brass is prevented. This, however, is only a comparatively slight improvement. On one of the roads visited mechanical lubricators have been installed just back of the cylinder saddle on a number of engines, these lubricators being actuated by a pendulum. Oil pipes connect to the inside end of the journal bearings which have cavities in the tops, and also an oil hole from this cavity to the hub and this mechanical lubricator continually forces a feed of oil to the bearing. Good success is claimed for this device

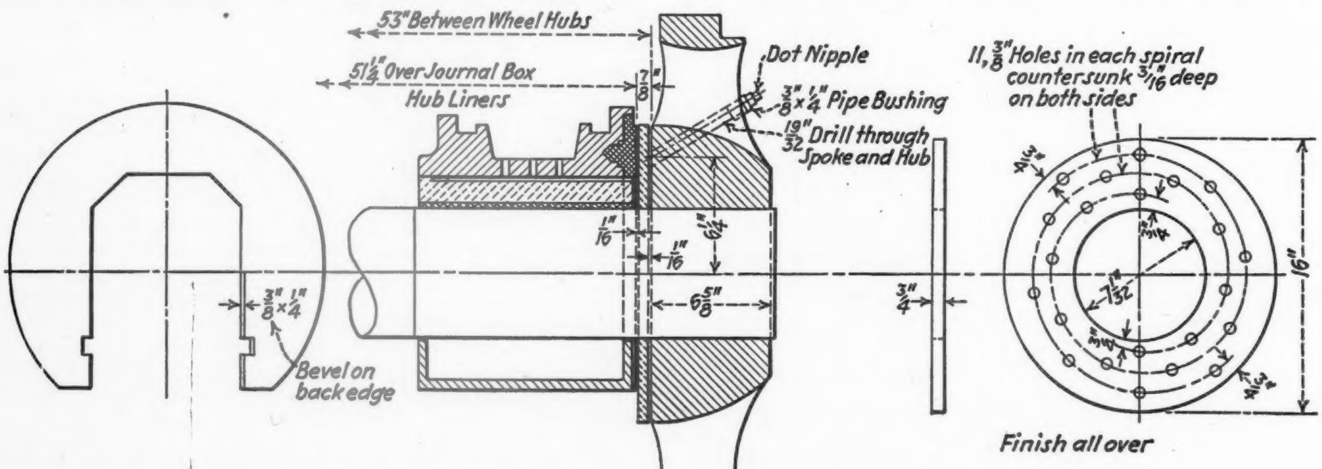


Fig. 3—Application of floating hub liner to engine truck

on this road. However, this does not dispense with the oily waste.

Floating Engine-Truck Bearings—On two of the properties visited, floating engine-truck bearings were in service, on one of them a combined bearing and hub plate on an inside engine truck bearing, and on the other a floating bearing on outside engine truck bearings. The inside bearing is lubricated with a grease cup containing a spring plunger using journal compound. One engine truck equipped with these bearings, 6½-in. by 12-in. journal, was inspected and bearings had made over 100,000 miles under four different Pacific type locomotives, the only attention given being the application of grease to the grease cups. The engine-truck wheels now require changing, having been turned down to the limit. The bearings are still serviceable. Where an inside engine-truck bearing is used, the committee is of the opinion that this type of bearing is ideal, and overcomes the many troubles inherent in the present types of engine-truck bearings and lubrication.

On another property visited, quite a number of engines were equipped with outside engine-truck floating bearings. The box is filled with grease forced in under pressure. These bearings have also proved very successful, and where outside engine-truck bearings can be used, it is our opinion these are also ideal and overcome the troubles above referred to.

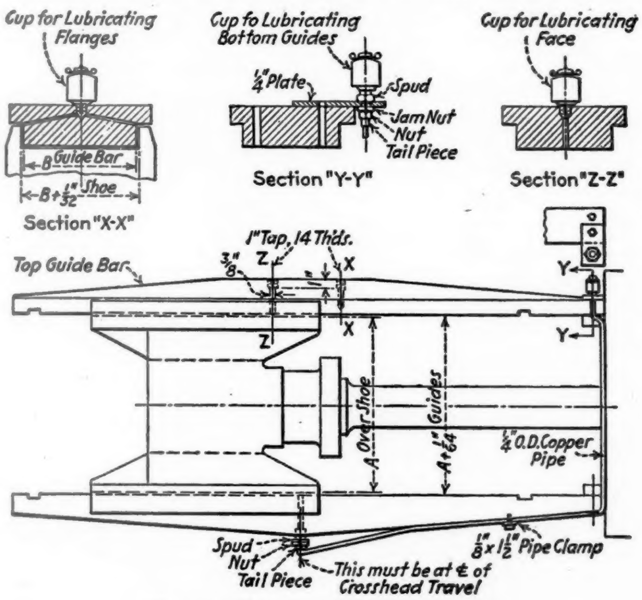


Fig. 4—Bottom guide lubrication

Engine-Truck Hub Lubrication

The practice followed for many years has been to lubricate the engine-truck hubs with the engineers' oil can, pouring the oil directly on the hub liners or into a waste-filled cavity on top of the box drilled to the hub liner. On one of the properties visited, some of the locomotives equipped with pressure grease system for valve gears, etc., have had applied a similar fitting to the engine-truck box, drilling to face of hub plate. What improvement this has effected has not been determined.

On one of the properties visited, the standard practice is to make use of a brass floating hub liner, drilling through the wheel hub from the outside, and apply a heavy graphite grease through a fitting similar to that used with the pressure grease system. This arrangement is illustrated in Fig. 3. The wheels are pressed off the axle and the floating hub liner applied; the hub face of the box is lined with babbitt, and whenever it is necessary to reduce the lateral wear, the face of the box is rebabbitted. This system of hub lubrication has reduced the lateral wear on engine-truck hubs approximately 75 per cent, and also decreased the running temperature of the engine truck journals. In the opinion of the committee, this is the most efficient system of engine-truck hub lubrication where waste-packed cellars are used.

Trailer Journal Lubrication

The committee has found no improved method of trailer journal lubrication since the present method of waste packed cellars was introduced along with the introduction of trailers, except that the roads which have eliminated the oil holes through the top of the engine-truck brasses have applied the same type of brasses to the trailers as are used on engine trucks. It appears that little trouble is being experienced with the lubrication of trailer journals; therefore, the need for improvement is not so apparent as is the case with engine-truck journals. The committee believes however, that a bearing similar to the floating engine-truck bearings above described will be a substantial improvement over the present oil and waste lubrication, as it will require far less attention.

Trailer Hub Lubrication

The information set forth in this report under the subject of Engine Truck Hub Lubrication, also applies to trailer hub lubrication. The road referred to which has adopted the floating engine-truck hub liners has also adopted them for the trailer hubs.

It will be noted that the system of lubrication and the design of hub liner is the same. As the trailers have an outside journal box, it is not necessary to press off the wheels to apply floating hub liners to the trailers, and the graphite grease is forced to the hub liner from a pressure fitting on the box instead of forcing it through the wheel hub as is done on the engine truck wheels. When the trailer hubs were lubricated with engine oil on Mountain type locomotives in territory where the curvature was severe, it was necessary to renew the hub liners, which at that time were pinned on, as frequently as 5,000 miles, whereas this work is now not required for 40,000 to 80,000 miles.

Guide Lubrication

On the roads visited, the committee found experiments being made with the pressure grease system for guide lubrication, using the same grease as is used on the valve motion, etc. While none of the roads has yet adopted this as standard, it appears to be proving entirely satisfactory. A metal plate is welded over the oil cavity in the cross heads, and a pressure fitting applied, the guide cups being removed from the guides. Some of the roads have connected the mechanical lubricators to top and bottom guides, removing the oil cups from the guides, the lubrication being accomplished with oil from the mechanical lubricator. This also has proved entirely satisfactory, in the opinion of the committee.

On one of the properties visited the bottom guides were lubricated by means of an oil cup attached to the top guide close to back cylinder head with ¼-in. o. d. copper pipe running to the center of the bottom guide, and oil is introduced to the guide surface through a ½-in. hole in the guide. The pipe must be clamped securely to the guide to prevent breakage. The committee believes this simple method, illustrated in Fig. 4, will produce efficient bottom guide lubrication.

Crank-Pin Lubrication

On all of the roads visited, the committee found that on heavy power the back-end main rod and middle-connection brasses have been superseded by floating bushings. Those in charge on these roads were unanimous in stating that their experiences with floating bushings have proved them vastly superior to the old style split brass. Three different methods of fitting the floating bushings in back ends of main rods, were observed. On one road the usual fixed iron bushing is omitted, the bearing fit in the rod is ground and the floating bushing is bored 1/32 in. larger diameter than the pin and a slip fit in the rod. On another road, a fixed iron bushing is used in the rod, and the floating brass bushing is bored a slip fit on the pin, and the outer surface machined 1/32 in. smaller diameter than the bore in the iron bushing. On the remaining roads, all using a fixed iron bushing, the floating brass bushing is bored 1/64 in. larger diameter than the pin, and 1/64 in. smaller than the bore of the iron bushing. The committee believes the last named practice the best.

On two of the roads visited, it is the practice to cut rod-cup grease into wafers about ½ in. thick in the oil house. They are issued to the rod-cup fillers in clean buckets. The rod-cup fillers are required to hold the rod-cup plug in one hand while

applying the grease. Grease is applied by picking up one wafer at a time with a tool similar to an ice pick, and placing it in the rod cup. This method prevents the entrance of foreign matter into the rod cup when being filled, and is recommended by the committee. On two roads, it was found that the rod-cup grease is also issued to the enginemen in wafer form in tubular cardboard containers, which protects it against contamination while being carried on the locomotive. On two of the roads visited, it was found that the usual rod cup and plug has been superseded by a pressure system, a different type of pressure system being used on each of these two roads. So far as efficient lubrication is concerned, there does not appear to be any advantage in the pressure system over the ordinary screw plug. If there is any advantage in the use of the pressure system, it consists of reducing the time required to fill the rod cups. The committee is not in position at this time to recommend either for or against the pressure system for crank-pin lubrication.

Mechanical Lubricators

The performance of various types of mechanical lubricators was studied by the committee. The mechanical lubricator has proved itself very efficient and a reliable device. It eliminates the human element, and at all times when the locomotive is in motion the oil is automatically fed to the parts connected to the lubricator, and when the locomotive stops the feed of oil automatically stops.

An interesting development in connection with mechanical lubricators was inspected by the committee on one of the roads visited; i. e., a device known as an atomizer, which provides for mixing steam with the oil after it leaves the mechanical lubricator and also provides for lubricating two or more parts from one lubricator feed. The performance of this atomizer on this road indicates more efficient lubrication and a substantial increase in the miles per pint of oil. The atomizer is shown in Fig. 5.

At one of the shops visited, a portable tank for filling mechanical lubricators was inspected. This device effects a substantial economy in labor filling these lubricators.

On one of the properties visited the committee inspected a modern locomotive on which the main drive boxes are lubricated with oil fed from the force-feed lubricator in place of driving-box grease. This is reported to give entire satisfaction and is an experiment that contains interesting possibilities.

Pressure Grease System

On three of the roads visited, the committee inspected the pressure system of grease lubrication as applied to valve motion, including link blocks and pins, shoes and wedges, spring rigging, buffer faces between engine and tender, and stokers. This system of lubrication was found entirely successful. Grease is applied to the spring rigging once each 30 days, the valve gear about once each 1,000 miles, and to link-block pins and hub plates where used, about once each 500 miles. On one of the roads visited which has about 350 locomotives equipped with the pressure system of lubrication, the committee was afforded the opportunity of inspecting a Pacific type locomotive being dismantled for heavy repairs. This locomotive had made 106,900 miles since the pressure system was applied. There was only one bushing in the valve gear and one pin in the spring rigging that required renewal.

At one terminal, the committee checked the operation and material required to condition a Mikado type locomotive equipped with a pressure system. The result of the check is as follows:

Greasing engine all over, 182 points	34 min.
Greasing engine motion work and driving boxes	8 min.
Greasing engine motion work	4 min. 20 sec.
Greasing engine rods	2 min.
Amount of grease used—total engine	3½ lb.
Amount of grease used—motion work and driving	1½ lb.
Amount of grease used—motion work (boxes)	¾ lb.

All the above time was computed as follows: The grease machine was full and standing beside the locomotive with the air hose attached and detached from the enginehouse air line between each operation. The whole machine was carefully weighed before and after each operation. The above operations were completed by one man.

It is the opinion of the committee that all modern power should be equipped with the pressure system of lubrication, and that the investment is amply and quickly repaid in the reduced amount of wear on the parts lubricated.

Lubrication of Air Cylinders of Air Compressors

The successful lubrication of air cylinders of air pumps has been a problem for many years, and is as yet unsolved. These cylinders require some lubrication to prevent scoring, but the amount required is so small, that any excess is immediately reflected in carbonization of ports and passages.

The committee is not in position to recommend any changes in present methods; but further study is being given this subject.

Conclusions

Under present day conditions with long locomotive runs, and the locomotives pooled, we believe the present practice of lubricating the locomotive with engine oil should be improved. The adoption of the methods of lubricating engine-truck, driver and trailer bearings, valves and cylinders, guides, valve motion, spring rigging, and stokers, set forth above, will dispense with the use of the engineers' oil can entirely. The lubricants should be applied in the roundhouse, and when so applied it is definitely known that the locomotive can traverse a distance of as much as 1,000 miles without further attention. We believe that the conditions of today demand definite, positive and efficient locomotive lubrication, and the methods recommended in this report will accomplish this and thereby very substantially reduce locomotive maintenance and, in addition, reduce to a minimum troubles with hot bearings.

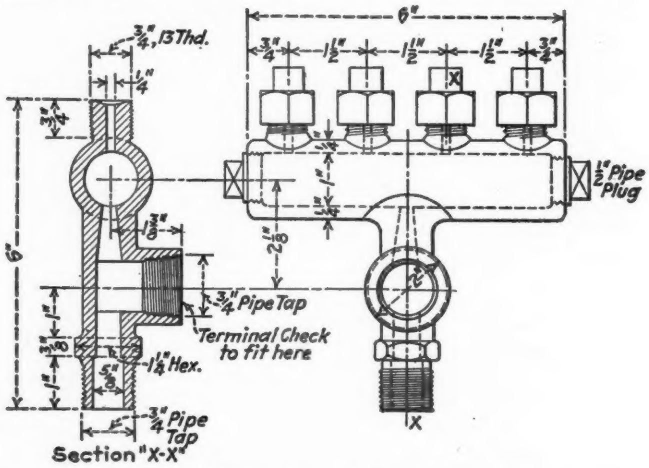


Fig. 5—Mechanical lubricator atomizer

The sub-committee report is signed by E. Von Bergen, chairman, I. T. Burney, and A. L. Moler.

Lubrication of Cars

Since the report of this committee last year there have been numerous requests from railroad members for an extension of the effective date of Rule 66, due to the fact they are not as yet fully prepared to meet the specifications covering reclaimed oil and waste. This extension has been granted by the General Committee.

The committee last year set up proposals for standard practice for the following:

1—Method of packing journal boxes.
2—Specifications for dust guards.
3—Packing tools for journal boxes.
4—Specification for reclaimed oil.
5—Specifications for new waste for journal-box packing.
6—Inspection of journal boxes.
7—Passenger-car lubrication.

These were submitted to the members in letter ballot Circular D. V. 596, and all propositions except specifications for dust guards were adopted as standard practice, effective March 1, 1929.

While proposition No. 1 was carried, a review of the replies suggested to the committee that further inquiry should be made into that part of the proposition reading:

> Before applying journal bearings, they shall be thoroughly clean and be bored or broached to a proper contour in order to secure a uniform bearing on the journal and to remove irregularities, also to detect imperfections in the linings.

Tabulation of these replies indicated that 55 per cent of the railroads representing 64 per cent of the total freight-car ownership do not follow this practice. It was not the intention of your committee to impose any hardship upon the railroads and in view of the position taken by many of the roads it was decided to recommend that this provision of proposition No. 1 be made recommended practice instead of standard.

Several roads have objected to the requirement that a "Relined journal bearing shall not be used unless at least a 1/32-in. cut has been taken by boring the shell before same is tinned or relined." The reason for this requirement is to insure a good mechanical grip of the lining on the shell and a true alignment of bearing face of shell. This prevents a great number of slipped linings in journal bearings.

Specifications for Dust Guards

In order to provide an improvement in the means for protecting journal boxes from dust and dirt the committee propose the following specifications for dust guards:

1. *Purpose*—To exclude dust from the journal box and to retain the oil.
2. *Requirement*—To serve its purpose when a new guard is applied, it must fit the axle with not more than 1/32 in. clearance all around.
3. *Material*—Material in contact with the axle must be of such composition that it will not cut the axle in service.

   The inside dimension of guard must be such that it can be easily applied to the axle, and of such outside dimension that it can easily enter the box.

   The guard must not bind when applied.
4. A wedge or plug shall be applied to close the top of the guard well in the box, or provision made in the construction of the guard to close this opening in order to exclude dirt.
5. *Service*—The service life of the guard shall be equal to at least the service life of a pair of new wheels.

A wood dust guard to meet these specifications must not be less than three-ply laminated, reinforced and secured by use of water-resisting glue.

Renovated Oil

While the specification for renovated oil was adopted by letter ballot, a number of questions have arisen concerning the ability of some member roads to meet the requirements. Claims have been advanced by some commercial concerns that oil and waste can only be renovated to meet the specifications by those concerns. The committee desires to acquaint the members with the fact that processes of oil renovation were developed by railroads that would meet all requirements of the specifications; before these specifications were proposed to the American Railway Association.

There are railroad-owned and operated reclamation plants in operation that are producing oil and waste, which meet A. R. A. specifications, located in different parts of the country. (The committee will furnish information as to location of these plants upon request.)

One method of renovating car oil is to place the dirty oil in an oil boiling tank (500 gal. capacity) where it is subjected to a high temperature by means of steam-heated coils placed near the bottom of the tank. The high temperatures (210 deg. F. to 220 deg. F.) cause the water in the oil to evaporate and pass off as vapor. After sufficient boiling, the oil is drawn off and placed in open-top settling tanks which are set over steam coils where it is kept at a temperature of about 140 deg. F., care being taken to keep temperature of settling tanks uniform.

After oil is placed in the settling tanks it is treated by sprinkling soda ash, 3 oz. to each gallon of oil, and then allowing it to settle. When settled sufficiently (6 to 12 hrs.) the clean oil is drawn off the top, ready for use and the sludge is drawn from the bottom of tanks. The sludge is used as center-plate grease, etc.

Another method used is to heat the dirty oil over a series of steam pipes to evaporate the moisture and then run the oil, at a temperature of 300 deg. F. to 325 deg. F., through a centrifuge.

Questions have been raised relative to viscosity and pour point requirements of this specification. The viscosity limits, 50 sec. to 70 sec. at 210 deg. F., permit a latitude that is generally satisfactory.

The pour point not to be above 45 deg. F. This places 45 deg. F. as a maximum, but no minimum was established. When reclaimed oil has a maximum pour point of 45 deg. F. it should be used in summer season or pour point reduced to the degree desired as suitable for seasonal use. This can be accomplished by adding a suitable new lubricating oil with maximum viscosity at 210 deg. F. of 40 seconds, pour point maximum 0 deg. F., and flash point minimum 290 deg. F.

The Specification for New Waste for Journal Box Packing as adopted will result in an improved grade of packing which will reflect in better lubrication performance.

In order to allow some tolerance of spooler and slasher content, the committee recommends that second sentence, Section two (b) of specification, be changed to read: "The threads shall be of clean, new cotton properly machined and thoroughly mixed 65 per cent to 75 per cent spooler and 25 per cent to 35 per cent slasher."

Inspection of Journal Boxes

There has been a decided improvement in lubrication practices in some sections of the country due to the increased attention and improved methods practiced. This committee formulated rules to bring about an improvement in the condition of journal boxes and where these rules are in practice the number of hot boxes has decreased and much better operating conditions now exist.

But regardless of the number of rules recommended, or how carefully the matter has been studied, if the employees are not properly educated and followed up to see that instructions are carried out, desired results will not be obtained.

Specifications for New Car Oil

On account of the wide diversity in characteristics of the new car oils in use at present, the committee recognizes the importance of standard specifications covering new lead soap compounded, or straight mineral car oils, and recommends that the following be adopted as recommended practice:

	Summer car oil	Winter car oil
Flash	300 deg. F., min.	275 deg. F., min.
Sayboldt viscosity at 210 deg. F.	Min. 65 seconds	Min. 40 seconds
At 130 deg. F.	Max. 225 seconds	Max. 145 seconds
Cold test	Max. 35 deg. F.	Max. 0 deg. F.
Water	Max. 0.10 per cent	Max. 0.10 per cent
Tarry matter	Max. 0.10 per cent	Max. 0.05 per cent
Insoluble impurities (dirt)	Max. 0.10 per cent	Max. 0.10 per cent

The methods to be used in determining the above are as follows:

Degrees A. P. I.	Calibrated hydrometer
Flash	A. S. T. M. Method D-92-24
Sayboldt viscosity	A. S. T. M. Method D-88-26
Water	A. S. T. M. Method D-95-28

Cold Test

Provide a clean dry, four-ounce oil-sample bottle of the tall, narrow form. Fit it with a one-hole soft rubber stopper through which runs a suitable thermometer. The bottom of the thermometer should be ⅛ to ¼ in. from the bottom of the bottle. Fill the bottle to a depth of 1½ in. with the sample to be tested. The oil should reach to a point at least ¼ in. above the top of the bulb of the thermometer. Insert the stopper with its thermometer firmly, and place the bottle in a freezing mixture which will quickly cool the oil to 10 or 15 deg. below its cold test. Let it remain 45 min. At the end of the freezing period remove the bottle from the freezer, throughout this and remaining procedure, holding the bottle by the neck only, so that the oil will not be warmed by the hand. Allow the oil to soften spontaneously, by the warmth of the atmosphere only. Frequently stir the oil gently, first to the right, and then to the left, so as to keep it uniformly mixed. At every increase of one or two degrees invert the bottle. The "cold test" is the temperature at which the oil flows promptly.

Tarry Matter and Insoluble Impurities (Dirt)

Before weighing out the individual portions for the tests, hold a portion of the violently shaken sample at a temperature of about 212 deg. F., for two hours and shake frequently during the time. Weigh out the test portions immediately afterward. Weigh 5 grams of oil into a 200- to 300-c.c. Erlenmeyer flask. Add 100 c.c. of petroleum ether boiling below 140 deg. F. (If the portion of sample weighed out differs markedly from 5 grams, use 20 c.c. of petroleum ether per gram.) Stopper and swirl repeatedly until the oil is all dissolved and the solution is homogeneous. Let stand exactly one hour thereafter. Filter on a 9-cm. filter, keeping the funnel closely covered to prevent creeping. Wash with more of the same petroleum

ether until it runs through entirely colorless. Pay especial attention to the edges of the filter, where the oil is likely to concentrate. It is not necessary to bring all the insoluble onto the filter, if only the tar is to be determined.

Next put 25 c.c. of redistilled chloroform into the flask and dissolve all the tar therein. Pour the solution on the same filter and receive the filtrate in a weighed 250-c.c. beaker. Continue washing the filter with the rinsings of the flask and wash further until the filter is free from tar and the washing run through colorless. Evaporate the chloroform solution to dryness, lay the beaker on its side in an oven at 212-221 deg. F., dry for one hour, cool and weigh.

To determine the miscellaneous dirt in the oil, the first filtration should be on a weighed filter and all of the residue should be brought onto the filter during the treatment with chloroform. Use a policeman if necessary. The matter insoluble in chloroform is "miscellaneous dirt." Weigh the residue plus filter after drying at 212-221 deg. F. for one hour. Calculate percentage by weight for both determinations.

The committee suggests that the above recommendations proposed be placed before the members for adoption by letter ballot.

The committee would earnestly recommend that a resolution be passed at this convention that Rule 66 be made effective January 1, 1930, and no further extension granted.

The report is signed by G. W. Ditmore (chairman), master car builder, Delaware & Hudson; H. W. Johnson, superintendent motive power and rolling stock, Minneapolis & St. Louis; P. Maddox, superintendent car department, Chesapeake and Ohio; T. O. Sechrist, assistant superintendent machinery, Louisville & Nashville; M. J. O'Connor, mechanical inspector, New York Central; C. B. Smith, engineer of tests, Boston & Maine; E. Von Bergen, general air brake, lubrication and car heating engineer, Illinois Central; and A. J. Harner, lubrication engineer, Union Pacific.

Discussion

[In the absence of Chairman Ditmore, the section of the report on locomotives was presented by E. Von Bergen (I. C.), and the section on cars by Carl Dierks (D. & H.)—EDITOR.]

R. D. Hawkins (Atlantic Coast Line): I represent one of the roads objecting to the boring of the brasses to be rebabbitted. As I stated at last year's meeting, by putting the proper contents of tin in the mixture, we had no trouble whatever, in successfully rebabbiting. In our estimation, it is simply a waste of material. Most brasses are removed not on account of the wear in the lining, but because of the collar wear.

There is another matter in the report that I wish to refer to. On railroads in the condition of those in the extreme southeast, they rather questioned the proposition of putting Rule 66 into full effect on January 1, 1930. Our managers have questioned expenditures.

W. A. Pownall (Wabash): Looking at the exhibit in the locomotive section of the report, I notice an internal check is shown on top of the boiler. Has the committee considered the distance of that check from the point where the oil enters the steam pipe from the cylinder? We have had some trouble with mechanical lubrication where we have the internal check very far from the steam pipe or the cylinder, and this is quite a long way away. Does the fact that this atomizer is used affect that situation?

Mr. Von Bergen: On the road that has gone into this atomizer to a greater extent than any other, I can say that no trouble has been experienced with the location. There are two or three other railroads that also have this atomizer on a few locomotives, and thus far no trouble has been experienced with the internal check in that location.

The boring of the journal-brass shells, when the brass is lined, was considered at great length. The members of the committee have had opportunities of observing and inspecting brasses that have been relined without boring of the shells and linings that have been bored, and the evidence was overwhelmingly in favor of boring the shell when the lining was applied.

As a rule, when linings are rebabbited in railroad shops, and the babbit melted out of the old bearings is accumulated and again melted and poured into the bearings, except at certain well equipped shops, there is no method of determining what percentage of the tin remains in the babbitt. So far as the loss of material is concerned, the committee now has under advisement a recommendation to be submitted next year which will permit of 1-32-in. cuts being taken. The loss of material with a 1-32-in. cut is very small.

F. H. Becherer (Central of New Jersey): I was very much interested in the question brought up by Mr. Hawkins in regard to the cost of reclaiming oil and waste. It might interest him and perhaps also some others that before the installation of our oil and waste reclamation plant, our cost of lubrication per thousand car miles was 13 cents. It is now three cents, five mills. This is on passenger cars. On freight, it was ten cents. It is now one cent and eight mills. There should not be any question at all in convincing the management that this is not an item of expense but one of economy.

A. G. Trumbull (Erie): The committee's report illustrates a number of devices and methods in lubrication of locomotives and cars which leads me to question whether or not they have investigated the patent situation and can assure the members they are safe in adopting these methods and processes and devices without risk of patent infringment?

C. T. Ripley (A. T. & S. F.): This question of oil specifications is so vital to the American railroads that I cannot help making a few remarks about it. There is too much of a general idea that any kind of oil can be put in a journal box. As a matter of fact, this is a very difficult type of lubrication. With all of the weather conditions, desert conditions, etc., you need a mighty good grade of oil, and therefore I am glad to see the committee working out a specification for new car oil, as well as for renovated oil.

I do disagree with the committee in its method of making the cold test. They stir the oil during the making of the test, and in this way get a more advantageous reading for the oil manufacturer, but not for the railroad company. There are two vital factors on which we must have protection. One of them is the development of stickiness characteristics when the oil is cold. The cold test is the nearest thing we have to this, but it does not tell the story alone. There is a need for the development of further apparatus and methods for measuring what happens to an oil when it gets cold; that is, will the waste stick to the journal? The other matter of the oil is the film strength. There is nothing in this specification to get any measure of the film strength of oil. When certain oils get very warm, they lose their entire film strength and the lubrication is gone; that is you can bring the oil to the journal, but it won't do you any good. Some new apparatus or methods are necessary, and I suggest that in dealing with the American Petroleum Institute the committee do not overlook these two factors.

Mr. Nystrom: I would like to ask the chairman of the lubricating committee two questions. What is meant by a reinforced guard? Does it mean that it should be fastened with copper nails, or what? The reason I ask this question is that I understand that it is more or less controlled by one manufacturer. The second question is in connection with the specification

for new car oil. The committee states that it recognizes the importance of standard specifications covering new lead soap compound or straight mineral oil. As far as I can see, the specification submitted is for straight oil, and no compound is specified or recommended. Mr. Ripley says the film strength of car oil is very essential. The past winter was one of the most severe in our history, and a great many railroads experienced considerable trouble, despite that every precaution was taken. Many of us are sure that it was due to improper car oil. We received the oil having an asphalt base which did not have the film strength. I would urge the committee to include, if possible, an additional specification for a compound oil either containing lead soap, fish or animal fat.

Mr. Von Bergen: As to the dust guard, the committee had in mind, in calling for a reinforced dust guard, any kind of a reinforcement that any manufacturer might wish to use in addition merely to pasting the dust guard together. It might be well if there was a strap surrounding it, or various methods that are in existence at the present time.

The specifications for the new oil that you read in the report will not be the same as those that will be on the letter ballot. In conference with the Committee on Specifications and Tests for Materials and with the Petroleum Institute, it is the intention, if possible, to draw the specifications so as to insure the railroads a good quality of oil.

Mr. Kinney: Under the subject of specifications for new oil, there is a question which undoubtedly all of you gentlemen have discussed among yourselves, but I am not so sure that it has been before the convention before. On the railroad, with which I am connected we have a very active discussion at the present time over the necessity of a summer and winter oil. We have been reliably informed that there are railroads in the United States that are using one grade of oil for both seasons, summer and winter, running through the different temperatures that we experience through our northern country.

Mr. Von Bergen: The committee has spent a great deal of time investigating and discussing the matter of adopting a year-around oil. All of us know that with cars running all over the continent in all kinds of temperatures, many of them are running in temperatures below zero, with summer oil in the boxes, and others are running in desert temperatures with winter oil in the boxes because these oils are not changed with the seasons. It would be impossible to do that. A subcommittee has been appointed which will soon begin an elaborate series of tests of services on cars with oils of various viscosities that are suitable for winter service to determine if they will stand up under the hot temperatures. The committee hopes at the conclusion of those service tests to be in position to tell you definitely whether or not a year-around oil is practicable.

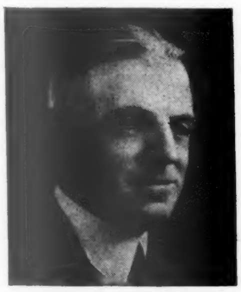
On the road with which I am connected, we have been running a passenger car for the past month—not on waste lubrication but on one of the oiling devices—with a winter oil, that is, 20 per cent below test. It has been riding through temperatures of over 100 deg. F., and the journals are running very successfully. In fact, you can hardly detect the difference in the temperature of the boxes adjacent to the journal and the truck frames.

Mr. Chambers: I move you that no time extension beyond January 1, 1930, be granted.

The motion was duly seconded and carried.
On motion, the report was accepted.

Heavier Car Loading Needed

By M. J. Gormley
Chairman, Car Service Division, American Railway Association



M. J. Gormley

The last time I talked to you, I believe, was in Montreal, two years ago, when I made some rather startling predictions about the matter of equipment. A great many of you thought at that time that I was either an optimist, or talking through my hat.

The problem for the future is how to continue to get net revenue by reducing operating maintenance. The greatest avenues open to you today, some of which have hardly been touched, are in heavier loading of cars, and decreasing empty mileage. How many of the Mechanical Division men know today that much of the empty car mileage is made on the railroads because of the condition of the equipment? How many of you grain-carrying railroads of the West know how many miles are made pulling grain out of the grain territory in cars that are not fit for grain handling? I am not one that believes that you can afford to maintain all equipment for the higher class loading all of the time, but do any of you know what failure to maintain equipment costs. If any of you do happen to know, and you are a little embarrassed or afraid to stand on your feet and tell me about it, write me a letter or see me alone, because it is brand new information to me.

We now have less equipment and more miles per car per day—something like 19 per cent over 1923. I have gotten so I don't like to use that car mile per car per day figure, because it is rather elusive. It depends on how many surplus cars you have, and how many are waiting repairs; in other words, the total car miles charged against total car ownership, whether in the hands of the shipper, the railroads, or moving, or otherwise. We now have figures of miles per car hour, in other words, what does the car do when it is actually in the train. These figures show that it is moving 314 miles every 24 hours. That is the figure I like to talk about, relative to the question of car miles per day.

With a reduction of 98,000 in freight cars, outside of refrigerator cars, you still have 225,000 surplus cars per day, after loading two million cars per week for eight straight weeks. I maintain that 225,000 surplus cars is too many. We should all work to get that 225,000 out of ownership—by buying more cars. Ask the railroad supply man. He knows where the 60,000-lb. capacity cars are, and I don't see why he does not go around and work on the different divisions. He could tell you that the new cars would do more work than two cars you had before. That is a sort of sales argument to advance. I have been termed one of the obstructionists, because

I have always advocated the decrease in ownership, but that is not to the detriment of the car supply industry. There is not a railroad in the United States today, bar none, that is not now operating some type of freight car equipment that ought to be in the scrap pile. I don't care what the railroad is, I will find some of those cars on every railroad, even among the best. I see Mr. Hardin of the New York Central with a smile on his face, and he knows it is true.

Mr. Aishton said that the load per car is going down instead of up, but that requires a lot of explanation. That includes L.C.L. merchandise. Eliminate it, and instead of the tons per car today being 27 tons, it is 35 tons per car. We have had an increase, 1.3 tons per car on the average since 1925, or 1923, I am not sure which.

Take the heavy items, and we have a greater increase in the tons per car of coal, ore, sand, stone, gravel and wheat, and other heavier loading commodities. That is the reason I say that the average carload figures are not worth the paper they are written on unless they are compared for commodities. We know if we get a 20,000 decrease in the number of cars of coal handled in one year, compared with another, and 100,000 increase in fruit and vegetables, you will have shown a reduction in tons per car, which has absolutely no relationship to the efficiency with which the equipment is loaded. I never like to talk about the improvements that ought to be made by railroads, unless I can show them that it has been done. And it can be done. The only outstanding reason today that we don't get greater tons per car is the inactivity of the transportation man in traffic departments.

Railroads Themselves Offenders in Light Loading

I might say something about the inactivity of the Mechanical Division also. How many Mechanical Division men or how many storekeepers ever check up to see whether the stuff they receive is loaded to the car capacity or not? You are one of the heaviest purchasers in the country and unless you do your part we can not get very far with the ordinary commercial shipper. We had four cars of lumber moving recently from the Pacific northwest to a point in Illinois with a light load. We checked up with the railroad to see why it didn't check on the car quantities. We found out it specified the quantity and it got four cars; an actual check showed that two cars would have taken the same material to the same place. Did they take any action in connection with it? Did they say to the shipper in the Northwest,, "You shipped us four cars and you should have shipped us only two?" They did not. That is the thing you have got to get into.

Last year, we had the 60,000-lb. and the 70,000-lb. capacity cars in the Southwest during the big grain movement. If we had had the 100,000-lb. cars we could have moved the harvest with 25 per cent less units. Incidentally the 100,000-lb. car would have earned on the average $90 per car more in net earnings every time that it moved than the 70,000-lb. car. The 100,000 car does not have to move very many times under those circumstances to pay for its excess cost and its excess weight.

Take this item of wheat. The tons per car in 1928 were actually 2.5 greater than in 1923. That is just the optimistic end of it instead of the pessimistic end that Mr. Aishton gave you yesterday.

Let me call attention to some more statistics. A coal company in the Southwest shipping 12 cars a day to one receiver reports as follows regarding its failure to use full capacity cars. At two different times in the past, trouble had been caused by cars jumping the track at the unloading dock. The mechanical department of the railroad serving them issued instructions that coal should be loaded to a level one foot lower than it had been, saying the trouble was caused by cars being unbalanced. This lowered the loadings per car 5 to 7 tons. Later investigation indicated that the trouble had been caused both times by the same car, which would indicate that something faulty about the car had caused the derailment, and not the fact that too much coal had been loaded. (Laughter.) I know some of you laugh and say that could not possibly be true, but it is the fact.

Here was a railroad that had something happen to its scales and so it issued instructions that the grain load must be reduced to fit the condition of the scales. During the time that it was making repairs we figured that it lost in net earnings enough to buy 25 new scales.

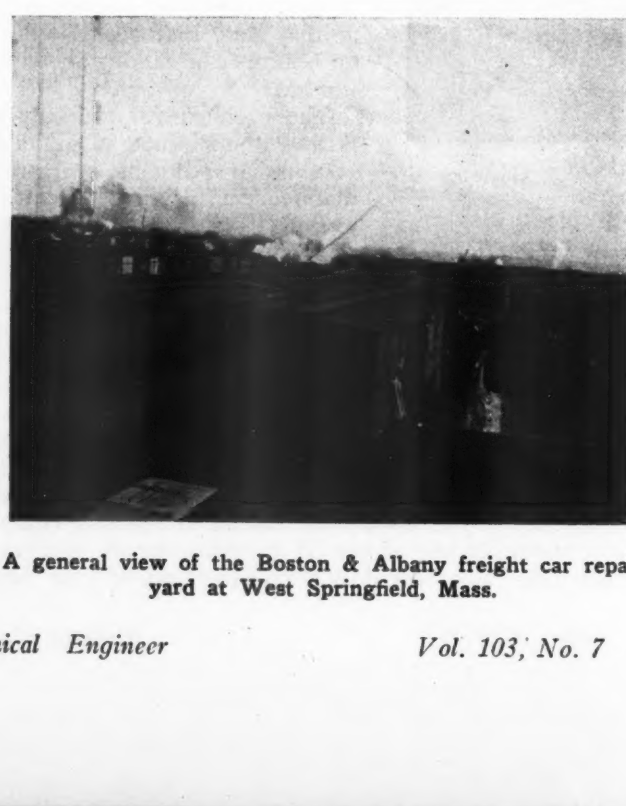
Cement Shipper Uses High Capacity Cars

We have a recent illustration right here in California. Just the other day I got a report from one of our men investigating the loading at a certain point who got them to change to a higher loading, and the increased earnings out of that plant in four days time was something over $4,000. He earned his salary for a year and then some.

Oiled steel sheets moving to consignee in the Mid-West were found to be loaded 26 tons to the car, freight charges $203.11. Upon solicitation orders were increased to call for 35 tons per car. Increased revenue per car $70.29.

When traffic people get around to soliciting business on the basis of the tons they get rather than the cars they get, they will help a lot. The average traveling salesman is interested in reporting to his boss that he got a lot of cars and if the boss would go back to him and ask him how much they earned and how lightly they were loaded, it would start something immediately.

A big company holding a contract to ship 3,500,000 brick to one consignee at one destination agreed to load to capacity. This means that 100,000 capacity cars will carry 122,500 pounds, earning revenue of approximately $150 more per car than with the previous loading.



A general view of the Boston & Albany freight car repair yard at West Springfield, Mass.

What Do You Know?

By Charles Dillon

Vice-President and Managing Editor of "Transportation"

I doubt very much whether there is in America today one other industry so highly departmentized as are the railroads. Under the influence of such organization employees and their immediate superiors become, eventually, very much like our highly successful scientific men: So immersed in the work before them that they see nothing else, think of nothing else, and become, finally, workers dedicated to one objective.

This departmentization is the chief reason why so few railroad men know very much about the affairs of the companies employing them, except in their own yards, divisions or departments; and in a way this is excusable. It is the duty of the managements to try, if they can, to induce the men in all departments to give some attention to the public relations of the companies; and I hope to convince you that if you don't begin pretty soon to take more interest in such questions it may not be necessary after a while.

I am not trying to say something sensational when I assure you that some very wise and serious men in this nation today are wondering gravely, and with good reason, just how long the people imagine the railroads can continue under the present unprofitable conditions. With everything going out and very much less coming in—well, I can think of only one institution that can be operated successfully under such conditions year after year, and that is a penitentiary.

I believe I know the average employee's viewpoint about the management of the road for which he works. And it isn't likely to surprise you when I say that this viewpoint in most cases is entirely wrong. It is wrong because the average employee, in any department, knows precious little about what we call railroad problems, relations between company and public, national and state regulations, the actual details of the company's business.

It is a bit unfair to expect these men to study such questions as closely as do the men who have to talk about them in public, but it is not too much to ask them to have a general truthful picture in mind of just how their employers are compelled to scheme and strive to get anything constructive done in the interest of the shipping and traveling public under the irritating, restrictive regulations imposed upon the railroads today.

Educate Employees in Public Relations

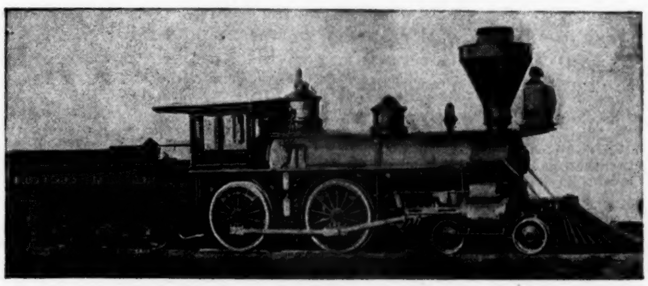
I hope to have some railroad official, executive or supervisory, achieve fame and probably gain promotion by asking the president to have a competent person assigned to attend every meeting and convention of his department to speak for 20 or 30 minutes on the subject of public relations. The latest legislation enacted should be described plainly. Its effect on the road and probably on the employees themselves should be set forth clearly. I should like to have this speaker invite his audiences to ask questions, and I should like to have those questions answered unequivocally. The managements have nothing to hide. Frankness, clear publicity, will create a new feeling between men and managements. It is most distinctly a thing worth trying. Congress, as you know, goes into executive session or into committee of the whole frequently, to consider the state of the Union. Railroad associations should do the same thing.

Men often are led into error through lack of information or through misinformation. We have a few great railroads, so situated geographically that they always are favored with traffic density, roads that show big earnings and some large dividends for stockholders, but also we have hundreds that have no such pleasing conditions. Not many employees know much about these roads, and most of them are misled in reading their annual reports. In these days of new and constantly increasing competition railroad men everywhere should know more than they *ever* knew about the business of transportation. They should at least know that the principal competitors are not subject to the restrictions under which railroads of the United States operate at the present time.

Evening talks about these things can be made extremely interesting. The most attentive and most courteous audiences I have ever addressed were railroad employees, and this was true in times of strikes as well as during normal conditions. The men always are interested. But, for that matter, what employee is likely to be found lacking in sympathy and good sense when he learns that on the average, employees to the number of 387,000, with 14,000 locomotives, 12,000 passenger cars, 540,000 freight cars and other railway facilities to the total value of five billion eight hundred million dollars worked throughout the entire year 1928 to produce enough revenue to pay railroad taxes? Is he not likely to be impressed when he learns that it cost the railroads of America $1,079,417 every day in the year during 1928 to pay their tax bills?

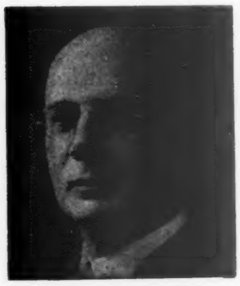
Isn't he certain to think seriously when he votes again for a legislator or congressman when he knows that these taxes amounted to more than $45,000 an hour for every 24-hour day of the year? Won't he study candidates when he learns that in terms of men, money and machinery, the tax-collecting agencies of the various governments, federal, state and local, took all the net revenue from 55,700 average miles of railroad lines, in 1928, a greater mileage than the total in the eleven Mountain and Pacific States, with North and South Dakota thrown in?

All these things, of course, are familiar to you gentlemen, but how about your men? Let me ask your careful consideration for these matters. Don't let yourselves become so wrapped up in your own departmental problems that you forget entirely the still larger and vastly more important problem of continued private ownership of railroads in the United States.



Atlanta & Charlotte Air Line locomotive No. 22 built by Baldwin in 1877—Cylinders 16-in. by 24-in.; 61-in. Diameter drivers; 130-lb. Boiler pressure; Tractive force 11,140 lb.

Report of Committee on Car Construction



A. R. Ayers
Chairman

The committee has been engaged for several years in producing designs for standard cars and the present status of this work is as follows:

1—Detail designs for the following cars have been produced and adopted as recommended practice:

(a) Single wood-sheathed, steel framed 4C and 4D box car.
(b) Double wood-sheathed, steel framed 4C and 4D box car.
(c) Steel framed 4C and 4D stock car.

2—General designs have been produced and adopted as recommended practice for the following cars and complete detail designs will be produced:

(a) Double wood-sheathed, steel frame 4C and 4D restricted interchange automobile car (to be completed this year).
(b) Double wood-sheathed, steel frame 4C and 4D unrestricted automobile car.
(c) All Steel 4D and 4E hopper car (to be completed this year).

3—Complete design has been produced for an all-steel box car 4D and approximately 30,000 such cars built although the design has not been adopted by the Association. This design, however, is available for anyone desiring to build this type of car.

4—General designs for all-steel high side gondola cars 4D and 4E have been prepared. The committee has made a preliminary study and found that due to the rapid change in the use of this kind of car many different types are needed to suit traffic requirements.

5—A considerable amount of work has been done on designs for a refrigerator car and the designs are well in hand. It is the feeling of the committee, however, that this also is a special proposition and that different types of cars will be required for different conditions; also, that such cars are generally privately owned.

This entire subject was referred to the General Committee and instructions requested. The General Committee has instructed the Committee on Car Construction to complete and bring up to date its detail designs for box, automobile, stock and hopper cars, and to recommend for adoption a design of all-steel box car and then discontinue designing other types of cars for the present.

The limiting outline within which the committee has been designing cars has been referred to the Engineering Division to see if it can be increased to permit of designing cars having greater dimensions for general interchange service. If and when this clearance diagram is increased, designs for house cars will be modified to meet it.

The committee will continue to develop details of cars already designed, based on maintenance and service experience.

Following the practice of recent years, your Committee on Car Construction has delegated the various assignments given them to sub-committees, whose reports follow:

Fundamentals of Design

In April, 1925, your subcommittee submitted a report, appearing as Appendix A of Circular No. D. V.—400, with respect to fundamental methods and assumptions for the design of box cars. This report was divided into four sections and contained thirteen exhibits as follows:

Section 1. Recommended specifications for fundamental calculations for the design of box cars.

Section 2. Recommended changes in the design of the existing single-sheathed box car, resulting from analysis of stresses and deflections submitted in detail in the following exhibits:

Exhibit A. Calculation of stresses in side framing members, Pratt truss.
Exhibit B. Calculation of stresses in underframe members.
Exhibit C. Calculation of deflections in underframe members.
Exhibits D to K. Graphic diagrams showing reactions, deflections and bending moments in underframe members under certain assumptions as to rigidity of supports and location of cross-bearers.
Exhibit L. Details of horizontal bracing recommended for use in plane of side plate at door opening of cars not provided with riveted all-steel roof construction.
Exhibit M. Calculation of stresses in side framing members, Howe truss.

Section 3. Review of recommended specification, discussing in detail the loads, forces and stresses considered by your subcommittee in connection with preparation of the specification.

It was explained under this section why the three moment theorem was recommended for use in making underframe calculations and why no provision was made in the specification for centrifugal force, longitudinal force, eccentricity and oscillation.

Section 4. Review of recommended changes in design, setting forth the reasons for these changes as evidenced by the calculations.

The most important change was the relocation of the crossbearers at the door posts, thereby reducing by 37 per cent the load transmitted to side trusses through crossbearers, reducing by 75 per cent the maximum deflection of the center sill, reducing by 29 per cent the maximum bending moment in the center sill, and permitting a reduction in the weight of the crossbearers.

It was further recommended that the car frame be shortened 3 in. (reducing the distance between truck centers by this amount) in accordance with verbal agreement among the members of the Car Construction Committee that this be done when any revisions were made in the existing design.

In June, 1925, the Railway Car Manufacturers' Association, in its comments upon this report, suggested that the allotment of 3,000 lb. against each end of body bolster be omitted, as it is believed that the stress occasioned by longitudinal shifting of cargo is taken care of by the diagonal brace in the underframe. In view of the fact that this load, if existent, is indeterminate, your subcommittee recommended that it be eliminated.

The Railway Car Manufacturers' Association suggested further that provision be made for stresses due to eccentricity where connections cannot be detailed so as to approximate concentric loading of posts and bracings. Your subcommittee recommended that such provision be made by inserting an additional clause.

In January, 1926, your subcommittee was requested to "prepare a list of revisions to date." This list was submitted in March, 1926, at which time it was pointed out that these revisions were of such a nature as to require a complete rewriting of the report. Your subcommittee stated that the revised calculations would include formulae for computation of bending moments in transom post and in door posts from pyramidal loads and that all calculations prepared by use of the influence line method would be omitted. The latter method was formerly employed because accurate formulae had not at that time been developed for pyramidal loads. It was further stated that additional data would be submitted in support of the statement that bending moment due to eccentricity will not increase the unit stresses at the ends of posts, which have been the critical locations.

In October, 1926, your subcommittee was instructed to increase the thickness of the floor plank 2¼ in. to 2⅜ in. in accordance with standard lumber dimensions. This change necessitated revision in the location of the bulging force.

In December, 1926, your subcommittee reported that this assignment had proceeded as far as practicable but that completion of the work would have to be held in abeyance because of uncertainty as to a contemplated change in the distance from truck center to face of striking casting. In the event of a change, the calculations would be subject to further revision.

Pending a decision, your subcommittee could proceed no further until October, 1927, when the distance from center of truck to face of striking casting was increased from 5 ft. 0 in. to 5 ft. 6 in. At the same time, the width of underframe was increased from 8 ft. 9 in. to 8 ft. 9⅜ in.

In April, 1928, your subcommittee presented a progress report, in which it was stated that the underframe deflection calculations would be omitted because of the work involved and, even though revised, it was evident that conclusions orginally reached, with respect to location of crossbearers and to effect of deflection of underframe members on distribution of loads, would not be affected by the changes. Your subcommittee was able to state at that time that the changes in underframe dimensions would not necessitate any alterations in the sections of the various side framing members.

Your subcommittee now submits its revised report, as follows:

Specifications for Fundamental Calculations for the Design of Box Cars. (In addition to recommended revisions, this specification has been drawn up to obtain a more logical arrangement of items.)

Engineering Specifications for 40 and 50-ton Single Sheathed Box Cars. (A. R. A. Standard.)

Calculations of stresses in floor plank and in underframe members.

Calculation of stresses in side framing members due to bulging and truss action. (Pratt truss.)

Calculation of stresses in side framing members due to bulging and truss action. (Howe truss.)

Calculations charts and descriptive matter in support of the statement that bending moments due to eccentricity will not increase unit stresses at ends of posts.

Details of horizontal bracing recommended for use in plane of side plate at door opening of cars not provided with riveted all-steel roof construction.

[Revised report referred to is not included in this abstract.—EDITOR.]

The report of the subcommittee is signed by C. R. Harding, (Chairman,) P. W. Kiefer, K. F. Nystrom, A. H. Fetters and B. S. Brown.

Single and Double-Sheathed Box Cars

All changes in design as per approved letter ballots have been incorporated in the drawings for the Manual.

Since the Westinghouse and New York Air Brake Companies have agreed to protect users of their new angle cock, with clamping attachments, against suit for patent infringement and assume the cost of such protection, the new angle cock design has been shown on drawings—the train pipe support at end has been modified to suit and note added.

Drawings showing end construction, flat and pressed plate, have been marked "Patented."

The design of combined striking casting and draft gear stop is considered preferable to a separate striking casting, carrier and front draft stop, due to its unit construction. The committee's attention was called to certain patent applications which seemed to involve this unit construction. Under patent law, if patents applied-for are granted and if the design in question infringes same, users would be liable for infringement. Therefore, drawing showing combined striking casting and draft gear stop, has been marked "Patent Pending."

A number of important questions have arisen during the past year pertaining to the construction of box cars which have necessitated further changes in the drawings as follows:

Grain Door Strip—Account of damage to lading on cars equipped with grain door nailing strip extending into car past inside face of lining, door post has been redesigned using "Z" bar section on which the grain door nailing strip is flush with inside face of lining. This construction being applicable to both single and double-sheathed cars and includes weather stripping and protection plates. In this connection it developed that a more effective weather protection could be secured on the single-sheathed car with a cast connection for intersection of door post and side plate, than with a pressed, as at present. This detail is also applicable to double-sheathed cars.

The application of this new door post arrangement necessitates redesigning the side framing, account of door posts moving 3 in. towards end of car. Changes were also made in underframe and brake arrangement drawings as it was thought advisable to maintain the present location of crossbearer relative to door post.

The above changes have been incorporated in drawings.

Door Sealing Device—Attention has been called to the door hasp as now shown in Manual. It has developed that it becomes disengaged in switching, etc., resulting in breaking of seal, and on this account some roads have discontinued using this design.

An improved type of sealing device has been developed which makes use of the present hasp fastener, the hasp and seal pin being the same for both types of cars. Due to the new door post construction, suitable brackets for the single and double-sheathed cars were developed.

This improved sealing device has been incorporated in the drawings.

Section Through Side of Car—In order to overcome objections of the Grain Dealer's Association and shippers of package freight, the section through side of car on the double-sheathed design has been modified as follows:

The bevel on belt rails and grain strip at floor and openings at lining, have been increased in order to facilitate the cleaning of grain from behind the lining, the lining also being extended to roof of car. In order to reduce the waste of lining to a minimum, the upper belt rail has been relocated.

Prints of the new section have been forwarded the Secretary for transmittal to the Grain Dealer's Association for criticism and new construction has been embodied in the drawings.

All recommendations have been investigated thoroughly and are free from patent infringement, except as will be otherwise noted on the standard car drawings.

The subcommittee report on Double-Sheathed Box Cars is signed by O. S. Jackson, (chairman) and J. Purcell.

The subcommittee report on Single-Sheathed Box Cars is signed by C. R. Harding (chairman) and B. S. Brown.

Double-Sheathed Automobile Cars

In accordance with the instructions, drawings for the 40 ft. 6 in. and 50 ft. 6 in. "Restricted" Automobile cars have been started. However, there has arisen a divergence of opinion as to the proper method of taking care of the distortion due to staggered door openings and until this question is disposed of a great deal of progress cannot be made. Tentative stress calculations for different combinations of crossbearer location and door openings have been made in order to determine the most feasible location of crossbearers, keeping in mind standardization of details and reinforcing of side sill and side plate, for the different designs to be developed. These calculations are now being revised due to the change in door post construction, and will be submitted to the Subcommittee on Fundamentals of Design for check. In the meantime work on such drawings as not dependent on stress calculations will be carried forward.

Since there is now no active demand for the "Unrestricted" Automobile car no further work will be done on this car until a report on the clearance diagram is received from the Engineering Division.

The report of the subcommittee is signed by O. S. Jackson (chairman) and J. Purcell.

Refrigerator Cars

The General Committee decided to discontinue the design of an A. R. A. refrigerator car for the present, with the understanding that the Car Construction Committee will continue to develop details of cars already designed based on maintenance and service experience, and will also continue to keep in touch with and cooperate with refrigerator car owners on fundamentals and details of refrigerator car designs.

The report of the subcommittee is signed by O. S. Jackson (chairman), J. Purcell, and C. R. Harding.

Self-Clearing Hopper Cars

The original instructions given were to design a 4 D (50-ton) and 4 E (70-ton) self-clearing hopper car as follows:

As many A. R. A. standards as possible to be adhered to, the capacity to be figured on 52 lb. per cu. ft. weight of lading, 2,500 cu. ft. for the 50-ton, and 3,000 cu. ft. for the 70-ton cars, to be figured with an average heap of 10 in., and to be as wide as adopted clearances will allow.

The designs as presented in 1928 were submitted to letter ballot, and instructions given to proceed with complete designs in detail. Your subcommittee accordingly has proceeded to complete the drawings covering both the 50 and 70-ton cars, and these drawings at present are well under way and will be ready for the next issue of Supplement to the Manual.

The report of the subcommittee is signed by W. B. Whitsitt (chairman) and B. S. Brown.

Stock Cars

In 1927 we presented two cuts, one showing a general arrangement of the car, the other an arrangement of the side door. We were later instructed to prepare complete designs of the stock car but since the width of the underframe for the single and double-sheathed box car has been changed and the center plate relocated, moving the trucks back 6 in. farther from each end of the car, it requires the revision of a number of drawings and the preparation of some new drawings.

Many drawings of the single-sheathed box car will be common to the stock car.

As soon as work in connection with single and double-sheathed cars is completed, the stock car will receive the necessary attention and drawings will be completed during the ensuing year.

The report of the subcommittee is signed by C. R. Harding (chairman) and B. S. Brown.

Journal Box Lids

In compliance with suggestion of the Committee on Lubrication that improvement in the means for protecting journal boxes is needed to insure their being dust and dirt tight, a subcommittee was appointed to look into this matter.

After investigation at inspection and repair points it was found that journal box lids on truck side frames with journal boxes cast integral are not being fitted nearly as well as lids on separate journal boxes. This is partly due to the difficulty in obtaining the proper relation of the journal box lug and bolt hole to the journal box face and the difficulty of grinding or machining of box face when cast integral with side frame and the further fact that even when properly fitted lids attached to integral boxes are likely to be damaged in transit. Since the use of cast steel side frames with integral journal boxes has become more general the fitting of the lids to the boxes has not been given the attention it deserves.

Your subcommittee feels that improvement in the manufacture and preparation of the journal box face, holding lug, and

bolt hole could be made which would insure a good foundation or starting point for the application of better fitting lids. Several suggestions for improvement have been made, some of which involve a substantial increase in cost and it has been decided to have your committee study this question still further during the coming year.

Practically all manufacturers of journal boxes furnishing the separable box as well as the integral box, are co-operating so that an improvement in the manufacture of frames and boxes can be expected even though no changes in specification or design are presented at this time.

Your committee feels, however, that it is possible to make much improvement in the design of the lids themselves independent of the face of the box and therefore propose for adoption the following revised specifications. [Italics indicate principal changes.—EDITOR.]

Revised Specifications for Journal Box Lids

1. Scope—This specification covers all lids for use on A. R. A. standard journal boxes.

2. Material—Lids *when* made of malleable iron *or cast steel* to be not less than *1/8* in. in thickness. *When made of pressed steel, thickness to be not less than 5/32 in. and material to have a carbon content of at least 0.25 per cent.*

3. Functions—(a) Lid must protect the packing by preventing the entrance into the journal box of dust, sand, fine coal, *snow, water,* or other foreign matter.

(b) Lid should prevent oil from working out of the end of the journal box.

4. Construction (a)—Lid to be attached to the journal box by *means of a pin, bolt or rivet 1/32 in. less in diameter than the size of the hinge lug hole in the box. The use of separable cotter pins or split keys is prohibited.*

(b) *Springs of the coiled type to be used, and preferably so located that the force on the lid in closed position shall be at or near the center of the lid.*

(c) *The above lid fastenings to be so arranged that the lid can be easily opened and closed, and retain itself in a fully opened position without danger of closing.*

(d) When closed, the tension between the lid and fastening must be sufficient to prevent vibration of lid or any parts thereof.

(e) Lids of the hinged type to have the hinge located at the top of the journal box, so arranged that the lid will open outward and upward to at least an angle of 90 deg. with the lid face of the journal box. Lids of other types should provide an equivalent opening.

(f) A tight contact between the lid and the face of the journal box must be maintained in order to meet the requirements as stated under Item No. 3.

For journal boxes used on passenger train equipment a machined fit is recommended *for the lid as well as the journal box. Die forming of lids, after pressings or casting, to insure a smooth flat surface where lid bears against face of box, will be considered equivalent to machining.*

(g) A ledge, flange, or other suitable arrangement *must* be provided on the inside of the lid, particularly along the lower part, so that oil thrown against the inside face will drain back into the box.

(h) *Top and side lips at least 1/4 in. in projection to be located around the outside edge of the lid except that side lips may be omitted where the lid itself is ground or machined.*

(i) The hinge lug must be housed.

(j) The eyes of *cast* lids must be integrally closed *their full length.*

Pressed steel lids to have the eyes carefully welded their full length or to have each eye secured by not less than two 3/8 in. rivets.

The eyes of the lid must be parallel with the contact face and gaged so as to insure a tight lid fit.

(k) *The inspection of lids that will insure complying with the above requirements is recommended.*

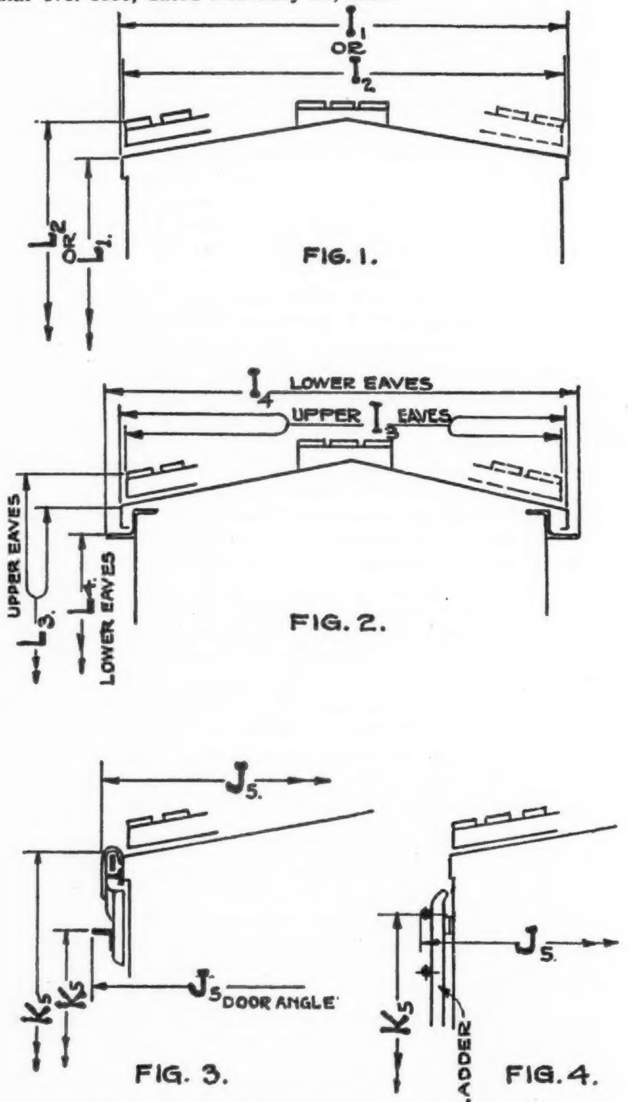
The report of the subcommittee is signed by C. L. Meister (chairman) and S. O. Taylor.

Marking of Eaves Width and Eaves Height on House Cars

In the early days the edge of the roof of cars was well defined definitely the widest part of car. This was in the days of double-board roof. When improved types of roof were developed the widest portion, or the edge, became still well defined by the fascia, and this continued until cars began to reach maximum limits and it was necessary in some cases to specially shape the upper part of the fascia so as to remain within clearance limits. With the advent of standardized safety appliances and latitudinal running board extension became an essential part of metal-roof cars, and its lower end often became the highest, if not the widest part of the edge of roof construction. Later the Z-bar side plate began to be extensively used, this forming what has been termed upper and lower eaves.

Marking of height and width of house cars at eaves has been shown first in recommended practice, and later standard, since 1896: *"That on all box cars standing more than 12 ft. from top of rail to eaves, the width at eaves be stenciled in 3-in. letters on side of car, as near the bottom as convenient."* For many years the Official Railway Equipment Register has published car capacity and dimensions information, but due to the many changes in design which have taken place in the more recent years, the original measurements have been increased in number greatly and it has now become difficult to select dimensions from those reported in the Equipment Register which may be stenciled on a car to any useful end for defining clearance conditions at the eaves. This difficulty has been recognized by the Transportation Division of the A. R. A., and information developed for the Equipment Register.

A discussion of this problem was presented to the Committee on Car Construction recently, which developed that the following dimensions of width and height around eaves should be reported, quoting from Official Railway Equipment Register Circular No. 1133, dated February 10, 1926:



Figs. 1, 2, 3 and 4—Clearance points at eaves

Outside Width—at Eaves or Top of Sides or Platform

I_1—Outside width of car ...... at top of eaves (except where cars equipped with latitudinal running board measurement taken from ......

I_2—Outside edge of top of latitudinal running board to corresponding point on the opposite side (for cars with ...... Z-bar side plate measurement should be taken at two points, one measurement representing)

I_3—Width at upper eaves (the other measurement representing)

I_4—Width at lower eaves.

Outside Width—Extreme Width.

J_5—Outside width of car ...... over attachment projecting to greatest extent.

Outside Height from Rail to Eaves or Top of Sides or Platform.

L_1—Outside height ...... measurement to be taken from rail to top of eaves at side of car (except where cars equipped with latitudinal running board measurement taken from)

L_2—Rail to top of latitudinal running board at side of car (For cars with ...... Z-bar side plate measurements should be taken at two points, one measurement representing)

L_3—Height from rail to top of upper eaves, the other representing

Outside Height from Rail to Extreme Width.

L_4—Height from rail to top of lower eaves

K_5—Height to outside extreme width of car ...... (Measurement should be taken from top of rail to point at which extreme width exists when measured over attachment projecting to greatest extent.)

Thus, it is seen that with the older type of car two widths and heights dimensions at eaves are reported to the Railway Equipment Register, and with the modern car with Z-bar side plate three dimensions of width and height are reported.

There are also shown in the Equipment Register two additional dimensions of height:

M—Height from rail to top of running board.
N—Height from rail to extreme height.

but these do not enter into this discussion.

Letter ballot on stencilling recently approved provides *"that cars with eaves height of over 12 ft. shall have the height and width of eaves stencilled on car."* Incidentally, it will be noted this is almost the identical language used in 1896 Proceedings. The idea of stencilling these dimensions on a car is to give advice as to whether car will pass tunnel or other close clearances, therefore it would seem desirable in the modern car to

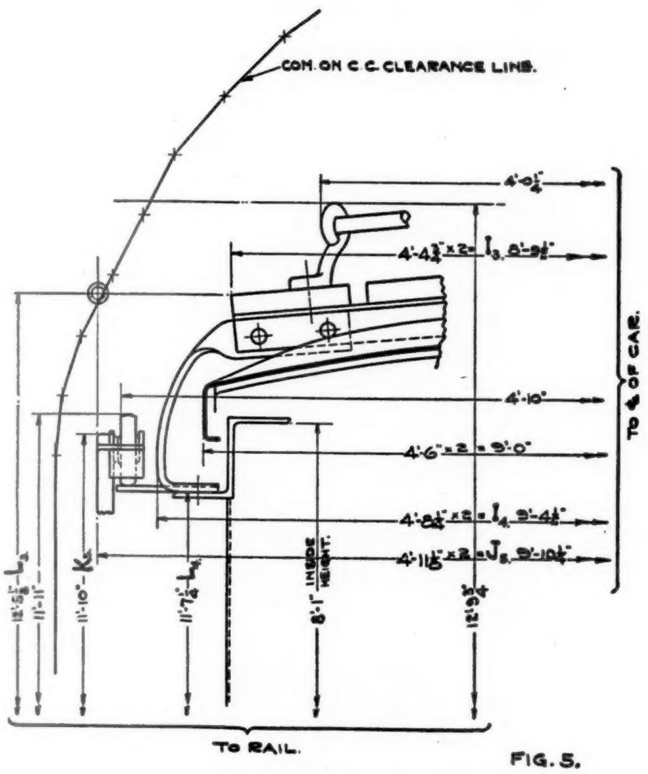


Fig. 5—Clearance points on a typical box car

more definitely define extreme widths and heights around the eaves.

If it were always true that the extreme width in the vicinity of the eaves was that part which either approached most closely to the clearance line or was projecting into the clearance line more than any other part, then these would be the dimensions to be placed on the car to indicate EW (eaves width) and EH (eaves height); but such is not always the case.

Fig. 5 shows a typical box car which is within the Committee on Car Construction clearance line.

Fig. 6 shows a typical western line automobile car which is considerably outside of the same clearance line.

In Fig. 5 the car has the Z-bar side plate and latitudinal extension. Three dimensions of width and height are therefore reported to the Railway Equipment Register:

I_3—Width at upper eaves, outside edge of top of latitudinal running board. This is 8 ft. 9½ in.
I_4—Width at lower eaves. This, on account of the bracket for latitudinal extension extending out beyond lower eaves, is 9 ft. 4½ in.
J_5—Extreme width is over the door hanger and is 9 ft. 10¼ in.
L_3—Height from rail to top of upper eaves (latitudinal running board); this is 12 ft. 5⅛ in.
L_4—Height from rail to top of lower eaves over the lower flange of Z-bar; this is 11 ft. 7¼ in
K_5—Height at extreme width (door hanger), 11 ft. 10 in.

In Figure 6, also showing a car with Z-bar side plate and latitudinal extension, the reporting dimensions are:

I_3	9 ft. 5½ in.
I_4	10 ft. 1⅜ in.
J_5	10 ft. 5 in.
L_3	14 ft. 1½ in.
L_4	13 ft. 4 in.
K_5	13 ft. 1⅜ in.

Which of these dimensions, when stencilled on a car as giving EW and EH, will convey the most reliable information to determine if a car will pass certain clearances? In Fig. 5 it is obvious that J_5 and K_5 most nearly approach the Committee on Car Construction clearance line. K_5, however, is by no means the highest point around the eaves of the car; the top of the latitudinal extension is over 7 in. higher.

In Fig. 6, I_3 and L_3 extend into the clearance line to the greatest extent. I_3 is by no means the widest part of the car, being 11½ in. narrower than the extreme width J_5.

At first thought a combination of the widest and highest dimensions might appear as the solution. By referring to Fig. 5 and 6 where this combination is indicated by a double circle, it will be seen that this would establish a point entirely outside of the car outlines and might even be outside of the clearance line, while, as a matter of fact, the car was actually well within the line.

Your committee, after study and conferences with the Records Committee of the Transportation Division, agreed to recommend the following revisions of the lettering diagrams for house cars now shown in Section "L" of the manual, pages 37, 38 and Fig. 1. Our reasons for recommending two sets of dimensions are because the cars have increased in size from the small car of years ago with a single square corner until the height of eaves has reached the clearance line and the corner

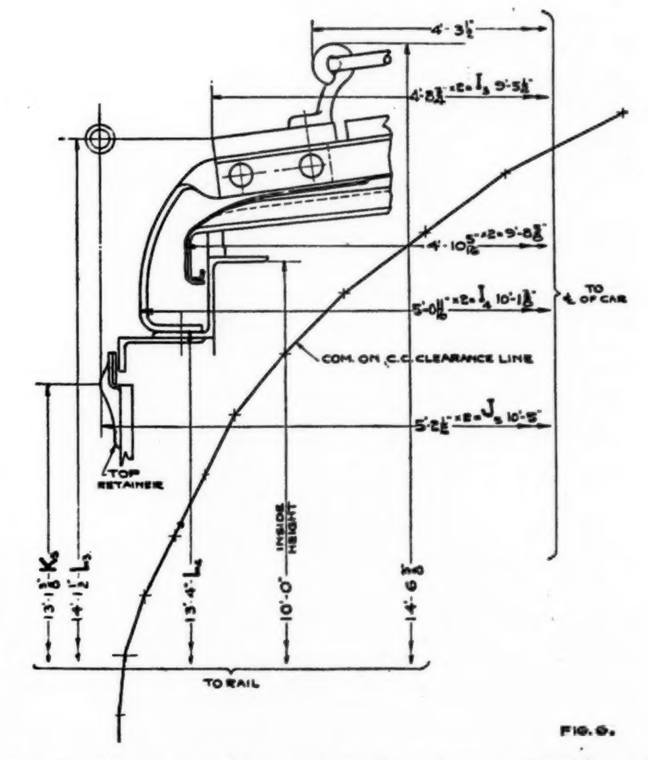


Fig. 6—Clearance points on typical western automobile car

has become rounded in an endeavor to build the car as large as clearances will permit.

Change paragraph 10, eaves clearances, on pages 37 and 38 to read as follows:

"On all box or other house cars standing more than 12 ft. from top of rail to eaves (upper eaves) two sets of dimensions shall be stencilled, indicating height and width.

"First: The height and width at eaves (upper eaves). If cars are equipped with latitudinal running board the height shall be given to top edge of latitudinal running board and the width shall be given from the outside edge of top of latitudinal running board to corresponding point on the opposite side.

"Second: The extreme width of car and the height at this extreme width. These measurements shall be taken over attachment projecting to greatest extent around eaves (top of side ladders, top door fixtures, etc.).

"Stencilling to be in 2-in. letters and figures on side of car, in location shown on drawing."

Fig. 1 should have Note 5 revised to agree with eaves clearance paragraph, with the exception that the last sentence should be omitted. It is suggested that Note 5 be divided into two notes: 5 and 6. Note 6 to start at "second" in the paragraph. This will require the renumbering of present Note 7 to 11, in-

clusive, to 8 to 12, inclusive. The stencilling of the car should be arranged as follows:

Note 5 EW 00-00 H 00-00.
Note 6 EW 00-00 H 00-00.

Your subcommittee feels strongly that the Committee on Car Construction clearance diagram should be made an A. R. A. standard, and recommends that appropriate action be taken toward this end at the proper time. This should, if possible, include the reconciliation of the A. R. E. A. equipment design line for third-rail clearance, and Committee on Car Construction present line. These are illustrated in Fig. 7.

Report of subcommittee is signed by C. E. Adams, J. McMullen and Geo. S. Goodwin.

Substitutes for A. R. A. Truck Springs

As instructed the subcommittee has concentrated its investigation principally on hopper cars of 50 and 70-ton capacity and refrigerator cars with the view of increased capacity as well as improvements in the truck springs and the use of additional springs.

To obtain this information a questionnaire was prepared consisting of nine questions, which was sent to 18 leading railroads. Fifteen of the roads replied. The replies are summarized as follows:

Question No. 1—Are you using A. R. A. standard springs on 50-ton and 70-ton capacity cars? If so, do they to any great extent go solid under full A. R. A. axle load requirements?

Seven roads reported using A. R. A. standard springs and arrangement on their 50-ton cars with satisfactory results; whereas, six reported having had some trouble. The remaining two roads reported not using A. R. A. springs or arrangement on their 50-ton cars. Five of the roads reported not using 70-ton capacity cars and of the 10 using 70-ton capacity cars, only one reported using the standard A. R. A. springs and arrangement with satisfactory results. This road, however, has the majority of its cars equipped with a special spring, this one lot of 70-ton cars being the only lot equipped with the standard A. R. A. springs. Two roads are using the standard A. R. A. springs and arrangement, but report having trouble with springs going solid and excessive breakage. The remaining roads answering this question stated they were no longer using the standard A. R. A. springs for 70-ton cars.

Question No. 2—If you are using any springs, not A. R. A. springs or A. R. A. springs which differ, either as to size, number of springs, number of nests, single or double coil, please furnish prints with specifications and the leading characteristics, including total weight of springs; total weight of plates, bolts, nuts, etc.; total weights of assembly single unit; height over springs without caps, free; height over springs without caps, solid; capacity of springs in pounds at 7¼ in. height without caps, capacity of the spring solid.

Twelve roads report using springs which do not conform to the A. R. A. standard; six of these are using springs of different size from the standard A. R. A. springs and six are using A. R. A. springs but have increased the number of coils.

The attached sheet marked No. A-1 (not included) shows information in regard to properties of the springs which differ from the A. R. A. In all cases a larger diameter bar is used and the total travel reduced. For comparison we have also shown standard A. R. A. spring with the standard A. R. A. arrangement; also the condition with nests consisting of six and seven A. R. A. springs. It will be noted in every case where there has been any change from the standard A. R. A. spring or arrangement, the stress in the springs have been considerably reduced.

Question No. 3—Prints of the truck assembly showing spring in position.

Question No. 4—Please advise reason for change from A. R. A. to spring which you are using and the date on which the change was made.

In every case where any change has been made from the A. R. A. the reason has been to secure additional capacity in order to avoid springs going solid and to reduce breakage.

Question No. 5—On old equipment using A. R. A. springs, are you specifying the new design for renewals during repair periods?

In the majority of cases roads now using A. R. A. springs on old equipment are not specifying any change for renewals during repair period; however, in a few cases where a special spring has already been adopted as standard, the use of the A. R. A. springs are being discontinued and are being replaced by the special springs.

Question No. 6—Advise if on future equipment the new spring will be specified, or if you have an improved spring as compared with the present standard.

In every case either a large spring or additional A. R. A. springs will be specified for future equipment of the 70-ton capacity; although, on the roads as mentioned in answer to question No. 1, which states they are now using the A. R. A. standard springs on 50-ton capacity cars with satisfactory results, they do not contemplate any change on future equipment of that class.

Question No. 7—Advise if you have used alloy steels and have obtained information of interest to the committee.

Twelve roads report they have not used any alloy steel springs. One road reports having tried out an alloy steel spring, which was found to be unsatisfactory and its use discontinued. Another road applied a lot of springs made of carbon vanadium steel to cars of 70-ton capacity and reports a reduction in spring breakage of 50 per cent. Another road is now experimenting with alloy steel springs, but sufficient time has not elapsed to furnish information of interest at this time.

Question No. 8—Advise if you have used springs differing from A. R. A. springs in the fiber stress with springs solid. If so, give the diameters of the bars and the stresses with spring solid, and the results obtained.

Sheet No. A-1 shows list of special springs not A. R. A. and their stresses when compressed solid. In no case has the stress of the outer coils been raised over 80,000 lb. and only in a few cases have the stresses in inner coils been raised to 95,000 lb.

Roads using these special springs report favorably as to the results obtained.

Question No. 9—What comments have you to make concerning the A. R. A. spring and what improvements do you suggest?

The general opinion is that the existing 50 and 70-ton capacity springs are inadequate for the loads they are required to carry and in most cases

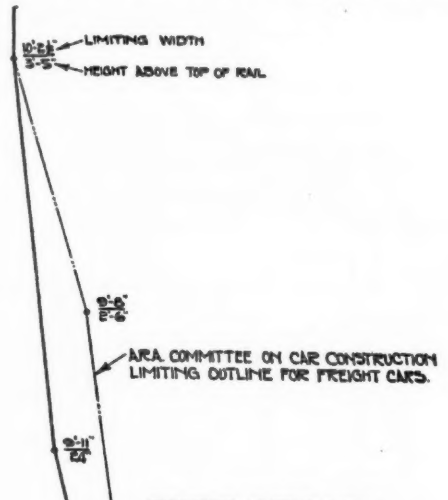


FIG.7.

Fig. 7—A.R.A. and A.R.E.A. clearance diagrams

the recommendation is to increase the number of coils, rather than change the design of the present A. R. A. spring.

It has also been recommended in several cases that better material be sought and better methods of manufacture be developed, especially heat treatment, and in some cases better workmanship.

For those roads which have used successfully heavier springs than the A. R. A., it has been recommended that the A. R. A. design be changed accordingly, but in practically all other cases the recommendation is to maintain the present A. R. A. design and increase the capacity by the use of additional coils.

Conclusion—In view of the many alternate designs which have developed, we believe the proper procedure before recommending any change in the present A. R. A. design of spring would be to continue the tests which are being made by the various roads until some positive information can be accumulated, and that the subcommittee continue its study for another year in order that a more comprehensive report be made.

The report of the subcommittee is signed by S. B. Andrews (chairman) and W. O. Moody.

Definitions and Designating Letters for Cars

Herewith are proposed revised or new definitions for various types of cars. With Refrigerator and Ventilator types an effort has been made to harmonize, as much as possible, the suggested definitions with those now in use by the National Perishable Freight Association.

In all cases it has been kept in mind that any radical change should be avoided as much as possible, and it is the opinion of your subcommittee that the changes, omissions and additions as recommended, can be made to advantage both as they effect the marking of equipment and also the designating markings in the Equipment Register.

[Italics indicate new or principal changes.—EDITOR.]

PASSENGER EQUIPMENT CARS—CLASS "B"

"BR"—Refrigerator Express. An *insulated* car constructed and equipped for passenger train service, having ice bunkers or ice boxes. *Designed primarily for use of chunk ice with means of ventilation* and suitable to carry any perishable commodity requiring *refrigeration or ventilation.*

"BS"—*Refrigerator Express. An insulated car constructed and equipped for passenger train service, and having brine tanks. Designed primarily for the combined use of crushed ice and salt, and usually without ventilating devices. Used chiefly for meats and packing-house products.*

FREIGHT EQUIPMENT—BOX CAR TYPE

"XA"—Automobile. Similar in design to general service box car, but with exceptionally large side *or side and* end doors.

"XAF"—*Automobile-Furniture. Similar in design to automobile car, but usually of larger cubic capacity and greater inside clear height.*

"XF"—Furniture. Similar in design to general service box car, but usually with greater cubic capacity.

"XI"—Insulated Box. Similar in design to general service box car, but either *wholly or partially* insulated. *Not equipped either with ventilating devices or for refrigeration.*

"XM"—Box. A house car used for general service and especially for lading requiring protection from the weather. Equipped with side *or side and end* doors.

"XT"—Tank Box. A house car without doors, either metal lined or enclosing a tank to hold water or other liquids.

"XV"—Box Car, Ventilated. (Omit—See Class "VA.")

CLASS "R"—REFRIGERATOR CAR TYPE

"RA"—*Brine-Tank* Refrigerator. A house car equipped with insulation and brine-tanks. Designed primarily for the combined use of crushed ice and salt and usually without ventilating devices. *Used chiefly for meats and packing-house products.*

"RB"—*Beverage,* Ice, Water or Vinegar Refrigerator. Similar in design to bunker refrigerator except that it is not equipped with either ice-bunkers or ventilating devices.

"RM"—Refrigerator or Produce Car. (Omit—use Class "RS.")

"RS"—*Bunker* Refrigerator. A house car equipped with insulation and ice bunkers. Designed primarily for use of chunk ice and also *with* means for ventilation.

"RT"—*Milk* Refrigerator. A car designed for transporting milk in bulk *under refrigeration.*

CLASS "V"—VENTILATOR CAR TYPE

"VA"—*Fruit-*Vegetable Ventilated Box. Similar in design to general service box car, but with *either end and/or side ventilators, and with or without double sliding side doors. When equipped with double doors, one door is solid and the other screened.*

"VM"—*Fruit-Vegetable Ventilator. Similar in design to ventilated box car except that it is partially insulated.*

"VS"—*Fruit-Vegetable Insulated* Ventilator. A house car equipped with insulation and *hinged swinging side doors,* and means of ventilation. Not equipped for refrigeration, *although sometimes provided with shallow boxes under hatches (or ventilating openings) to protect lading, but not to contain ice. Sometimes called "Produce Car."*

CLASS "S"—STOCK CAR TYPE

"SPR"—*Stock-Refrigerator. A combination poultry and refrigerator car, one end to accommodate live poultry and the other end suitable for dressed poultry, butter, eggs, etc., requiring refrigeration.*

CLASS "G"—GONDOLA TYPE CAR

"GR"—An Open Top Car, having fixed sides and ends and level bottom, with one or more hoppers dumping between rails, *or between and outside of rails.*

"GW"—*A Gondola Well-Hole Car for transportation of special commodities. A solid bottom car having one or more openings or depressions provided in floor, permitting the lading to be lowered in order to obtain overhead clearance.*

CLASS "H"—HOPPER CAR TYPE

"HFB"—*An Open Top Self-Clearing Car, having fixed sides and ends and bottom, consisting of one or more divided hoppers at center of car with doors hinged lengthwise, dumping inside rail; also cross hoppers at ends with doors dumping between, or between and outside of rail.*

CLASS "L"—SPECIAL CAR TYPE

"LO"—A self-clearing permanently enclosed car, having fixed roof, sides, and ends, and provided with openings for loading through roof *or sides.* Openings fitted with weather-tight covers *or doors.* Car also provided with bottom openings for unloading, with tight fitting covers or doors to prevent leakage *of such commodities as sand, etc.*

The report of the subcommittee is signed by C. E. Adams.

Maintenance of Arch-Bar Trucks

In 1928 recommendations were given for the maintenance of arch-bar trucks.

The increasing importance of properly maintaining arch-bar trucks is again emphasized. Permissible axle loads have all been increased over what the majority of arch-bar trucks were originally designed for and freight train speeds have continually increased. Under harder operating conditions arch-bar trucks are therefore, through age, becoming more susceptible to breakage. It is of utmost importance that all roads should thoroughly appreciate the necessity of improving maintenance to the greatest possible extent and it is recommended that special instructions should be issued in connection with the following details:

Arch-Bars—The use of oxy-acetylene torch for burning out bolt holes in old or new arch-bar trucks is prohibited.

Improperly matched bolt holes should be avoided. To assist in proper matching of bolt holes and to obtain the proper fit of arch-bars against each other it is recommended, when only one arch-bar is being renewed that the new bar be fitted to the bar that is retained and the old bar used as a template for drilling holes.

The Car Construction Committee recommends that the practice of turning up ends of bottom arch-bar around ends of upper arch-bar be made obligatory for all bottom arch-bar renewals and eliminates the alternate method of applying pin or rivet between journal box bolts for increasing shearing strength of connections between top and bottom arch-bar. This recommendation is made because worn holes and small journal box bolts make it impossible to distribute the shear equally between bolts and rivet or pin.

Existing drawings show a maximum of 1/32 in. clearance at the turned up portion of bottom arch-bar and tie-bar. It is recommended that this be increased to 1/16 in.

Bolts—Journal box and column bolts have been found in service with ends welded on. This is poor practice and no bolts that have been welded should be used in conjunction with arch-bar trucks.

Clean cut, full size threads should be insisted upon in order to obtain proper holding power between the holding nut and bolt and assurance that locking nuts will function properly when used.

Present standards call for the use of plate type nut locks and it is recommended that the drawing be altered to more clearly specify requirements. This includes change in the note to call for nut locks not less than 3/32 in. thick of soft steel and preferably of copper bearing material. Note also to be changed to call for common nut and lock nut for new bolts and this combination should also be used when length of old bolts will permit. Plates 1, 2, 3 and 4 containing changes referred to are attached.

General—Car Construction Committee desires to repeat that on account of being impracticable to construct a satisfactory arch-bar truck of strength, durability, and reliability equal to the cast-steel side frame, it strongly recommends against perpetuating arch-bar trucks by using old or reconditioned arch-bar trucks under new car bodies.

In recent years the carrying capacity of the smaller axles has been increased over the loads for which the trucks were originally designed and in addition, freight trains operate at much higher speeds. The increasing age of arch-bar trucks and the wear resulting from the multiplicity of parts make it increasingly difficult to maintain trucks of this construction in satisfactory condition to give the service required.

The Car Construction Committee has been willing to recommend certain increases in size of arch-bars and other modifications, some of which have already been adopted, and some of which are recommended this year, looking toward an improvement in arch-bar maintenance and performance and at the same time protect railroad investment as far as consistent with proper service. These improvements have not been recommended with the view of perpetuating arch-bar trucks indefinitely.

The Car Construction Committee earnestly recommends that individual roads consider a program for applying cast-steel side frames for renewals of broken arch-bars to a sufficient extent to practically discontinue the manufacture of new arch-bars, except as might be required for foreign cars.

It is felt that any added cost by reason of the application of

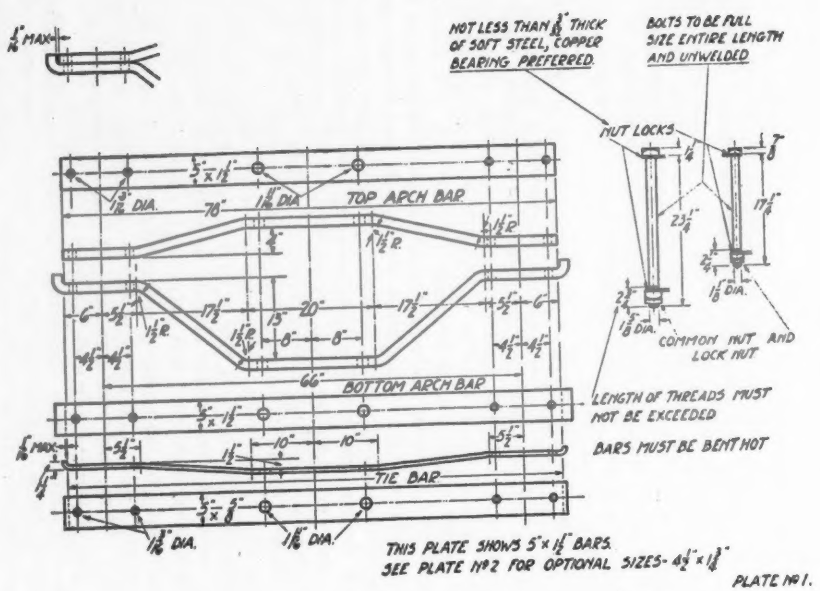


Plate 1—5 in. by 1½ in. arch bars for 40-ton trucks

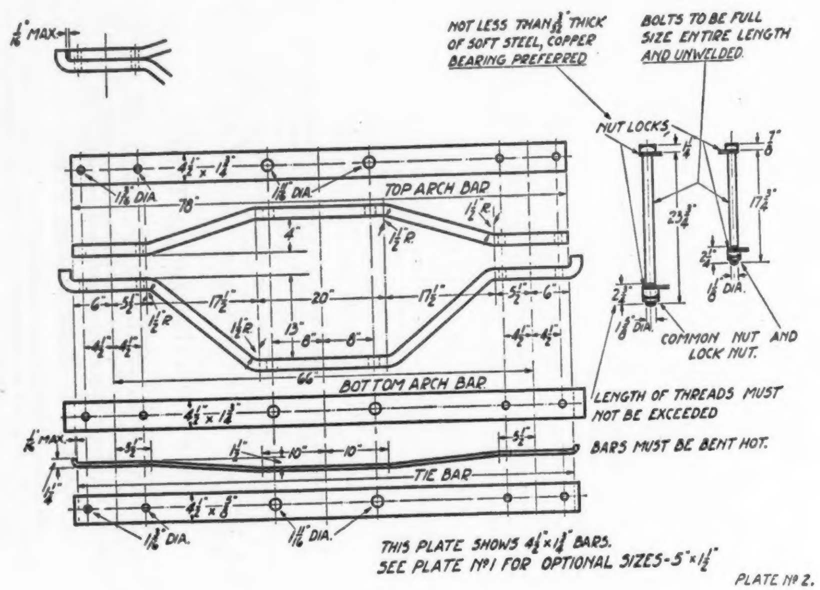


Plate 2—4½ in. by 1¾ in. arch bars for 40-ton trucks

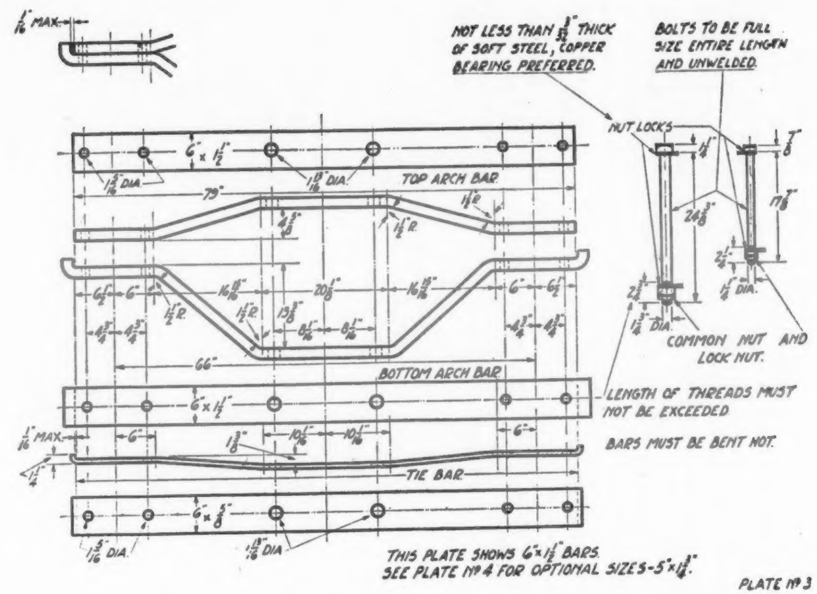


Plate 3—6 in. by 1½ in. arch bars for 50-ton trucks

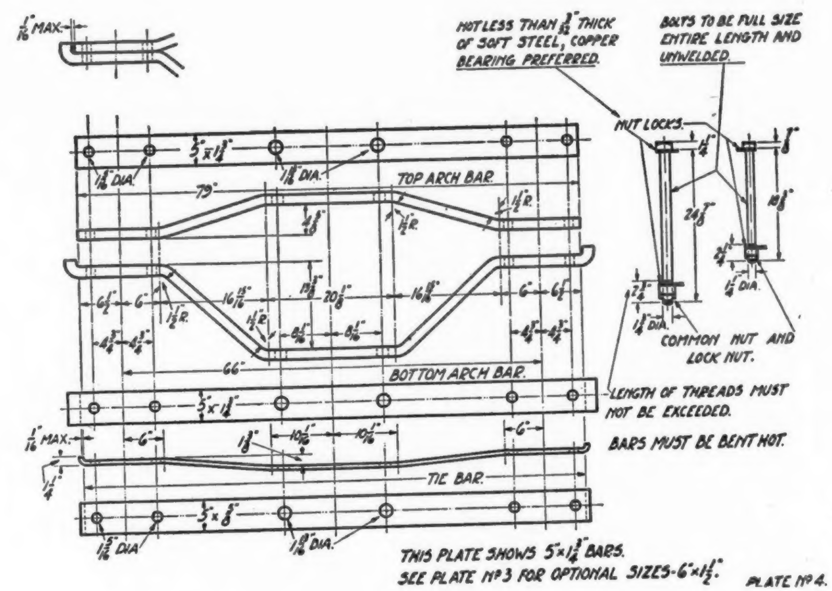


Plate 4—5 in. by 1¾ in. arch bars for 50-ton trucks

cast-steel side frames would be more than compensated for by—

(a) reduction of accidents.
(b) shortening of time in handling trains through yards.
(c) less delay of loaded cars.
(d) saving in cost of maintenance and inspection.

Attention is called to the desirability of having all trucks equipped with cast-steel side frames conforming to current A. R. A. specifications, at the earilest date practicable. To expeditate the work it is suggested that in the renewal by car owner of cast-steel side frames, or top and bottom arch-bars, in pairs, cast-steel side frames meeting current A. R. A. specifications be used. This will be recommended to the Association for adoption as recommended practice.

The foregoing recommendation has the concurrence of the General Committee and the Arbitration Committee.

The report of the subcommittee is signed by W. A. Newman (chairman), C. B. Smith and J. McMullen.

The report of the Committee on Car Construction is signed by A. R. Ayers (chairman), general manager, New York, Chicago & St. Louis, P. W. Kiefer (vice-chairman), chief engineer motive power and rolling stock, New York Central, O. S. Jackson, general superintendent motive power and machinery, Union Pacific, C. L. Meister, mechanical engineer, Atlantic Coast Line, J. McMullen, superintendent car department, Erie, John Purcell, assistant to vice-president Atchison, Topeka & Santa Fe, W. O. Moody, mechanical engineer, Illinois Central, C. B. Smith, engineer of tests, Boston & Maine, S. O. Taylor, master car builder, Missouri Pacific, W. A. Newman, chief mechanical engineer, Canadian Pacific, C. S. Goodwin, assistant general superintendent motive power, Chicago, Rock Island & Pacific, J. J. Tatum, general superintendent car department, Baltimore & Ohio, E. B. Dailey, engineer car construction, Southern Pacific, B. S. Brown, assistant engineer, Pennsylvania, S. B. Andrews, mechanical engineer, Chesapeake & Ohio, and K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific.

Discussion

A. R. Ayers (N. Y. C. & St. L.): I will ask the various chairmen of the sub-committees to present their reports.

[The report of each sub-committee was then presented by the sub-committee chairman or his representative. —Editor.]

Mr. Ayers: The report on fundamentals is pretty dry, but the Car Construction Committee feels it is a matter of considerable value, and the sub-committees are entitled to a great deal of credit. They have made an effort to set up the calculations for each car in an orderly way, with the basis of the calculation clearly set forth. It will probably be worth the while of your engineering department to make use of it, even though you do not see fit to use the standard design.

In working out the two capacities of cars, the sub-committee on self-clearing hopper cars has made a special effort to incorporate as many details as possible covering both designs, and I should have said that the same thing was done in connection with the single-sheathed and double-sheathed box cars, which was the reason the reports of those two cars was combined in one. If you will take the time to study the design, you will find a great many standards are common, and that applies all through the standard cars. That is one of the ways in which the standard designs will be most helpful.

The recommendation in the report on Marking of Eaves Width and Eaves Height on House Cars, as to the A. R. A. clearance diagram should apply to the diagram as finally worked out. In making that recommendation to the General Committee, the Car Construction Committee called attention to the fact that quite possibly the present clearance would be restricted by a few relatively unimportant obstructions, and we ask that consideration be given to the possibility of eliminating those few obstructions, or possibly leaving them out of consideration except to call attention in the equipment register as to what these obstructions are. We do not think it reasonable that a few unimportant obstructions should restrict the building of cars if they could be handled practically everywhere else.

S. B. Andrews (C. & O.): The alloy steel corporations and the spring manufacturers have all offered to give your sub-committee on Substitutes for A. R. A. Truck Springs all the assistance that they would require, even to the manufacture of springs of any composition they desire. The American Society for Testing Materials is giving co-operation. The sub-committee believes that there is no doubt that a great deal of progress can be made on alloy steel and helical springs.

Mr. Winship (Canadian Pacific): The Sub-Committee on the Maintenance of Arch-Bar Trucks had designs of 30-ton trucks prepared but they are not in shape to present now. We expect to have them in shape to submit next year.

Mr. Chambers: Are there no recommendations from the committee on increasing the weight of arch bars for 60,000-lb. cars?

Mr. Ayers: That was what Mr. Winship had in mind. We didn't quite get it finished. We have the increased size of arch bars for the 30-ton trucks. The drawings were made, but there was some question raised among the members of the committee, and that is the thing that we hope to be able to handle in time to put in the letter ballot this fall.

Mr. Chambers: I hope you will. I know there is a movement for discontinuing arch-bar trucks, and also for the elimination of 60,000-lb. capacity cars. but they will be with us for some time. I was surprised that several years ago when they changed the dimensions for arch bars on heavier capacity cars that some action was not taken for the 60,000-lb. car. It is running in the trains with all other cars and just as apt to cause failure as any other class of car.

Mr. Ayers: The statement was made that on account of it being impraticable to construct a satisfactory arch-bar truck of strength, durability and reliability, equal to the cast-steel side frame, the committee strongly recommends against perpetuating arch-bar trucks by using old or reconditioned arch-bar trucks under new car bodies. At least one member of the committee took exception to that statement, feeling that it might be used against those who operated arch-bar trucks, in the event of accident, and it is perhaps well to state in some detail what the committee had in mind.

The committee, of course, recognizes that many thousands of arch-bar trucks are in service, and will remain in service for a long time, but we meant that statement just exactly as it reads, that if you set out to build an arch-bar truck that has all the elements of a small number of parts, freedom from wear of parts in service, you are going to build the truck a lot different from any arch-bar truck that the committee knows anything about. We don't mean to say that it is not possible to build a safe arch-bar truck or to say that it is impossible to maintain it in safe condition, but you all know that an arch-bar truck is bound to have a lot of journal-box bolts and common bolts in it that a cast-steel side frame does not have, and if you run a truck of that kind, it is bound to require more cost of maintenance and more inspection and more delay in train yards. That was what we had in mind. We do not want to go on record that it is impossible to build and operate arch-bar trucks. We think it costs more and takes more

time and money, and the chances of their being maintained properly have been shown to be slim.

Mr. Demarest: What are some of the benefits that have accrued to the railroads from the tremendous amount of work this committee has done in the adoption of a standard car? It seems almost trite to make the statement that a standard car is going to be economical not only from the standpoint of construction, but also from the standpoint of business. That apparently goes without saying. We know that, when the railroads have placed orders for cars of standard construction, the builders generally will say that they can build the standard car very much more economically than they could build cars before they were standardized. In your own maintenance work the standard car is more economical because of the reduction in the different kinds of materials that you have to carry. While the railroads own the cars, the use of the cars is directed by the Car Service Division at Washington. Therefore, the cars on the foreign roads should be standard cars.

If there are to be special type cars, like refrigerator cars, the railroads have placed some of them in the hands of sub-corporations, with a local increase in useful mileage of those cars, and an improvement in their condition because they are constantly maintained. There is also an increase in revenue to the railroads which are parties to such arrangements.

I can see a further concentration of refrigerator cars in sub-corporations. I can see the same principle applied to stock cars. Why not? Perhaps finally it may get to a point where we will not have individual maintenance shops, but will also pool our car maintenance.

There is one situation that I deplore. That is the attitude taken by a great many railroads that they require slight variations in the type of cars. I deplore the indication of variations in cars of the same type. If you have a car of a special design, it is on somebody else's railroad, and the chances are it has not done very much good. I am strongly of the opinion that cars should be designed with as few variations from type as it is practicable to make them, and that variations should have the approval of the Car Service Division.

G. W. Rink (C. R. R. of N. J.): I desire to call the committee's attention to the diagrams covering the 4-D and 4-E hopper cars. The 4-D, or 50-ton car, indicates four hoppers, whereas the 4-E, or 70-ton car, indicates three hoppers. The dimensions from center to center of bolsters shown on these plans indicate that the plans are not correct. I also note that a distance of five feet has been established from the striking plate to the center line of the truck bolster. I believe this dimension should be increased in order to make provision for geared hand brakes. We have had experience in building steel box cars where this dimension, having been made 5 ft., did not provide the necessary clearance. These cars should also be designed to take a 90 ft. radius curve.

Mr. Ayers: The reason for making the distance 5 ft. instead of 5 ft. 6 in. is to avoid the sloping floor sheet. The committee will be glad to take under consideration the other points raised.

On motion, the report of the committee was accepted, with a rising vote of thanks.

Report of the Arbitration Committee

T. W. Demarest
Chairman

During the year Cases 1591 to 1631, inclusive, have been decided and copies sent to the members. A copy of these decisions is made part of this report. A vote of concurrence in the decisions is respectfully requested by the Committee.

In connection with report of the Sub-Committee on the Investigation of Cost of Preparation of Bills for Minor Repairs to Foreign Cars presented at the 1927 Annual Meeting, your Committee decided that a general study should be made of the cost of such billing and assigned this subject to the special Sub-Committee which has completed its investigation and its report is printed as Exhibit A attached.

As a result of this report, your Committee, with a view of effecting an immediate saving in the cost of billing, to facilitate the movement of freight trains through the yards and terminals and to permit inspectors to properly prepare trains for movement instead of preparing records of repairs made, is recommending that items of nuts, nut locks and lock nuts, applied separately, 1⅜ in. and smaller inclusive, be added to Rule 108, for which no labor or material charge may be made. If adopted, these three items, together with those added as a result of the 1927 recommendation, would result in the elimination of an approximate total of 85 per cent of the repair cards issued for repairs amounting to 25 cents and less at the time this study was made, or 36 per cent of the total repair cards issued for all repairs, while only 1.3 per cent of total money for all repairs is involved.

Your Committee has a further economic step in mind to reduce the billing cost by the elimination of detail labor charges covering labor and overhead, and the use of an arbitrary percentage to be added to the material cost; and proposes to make an investigation this year to ascertain if this arrangement is practical, reporting the result of its findings at the 1930 annual meeting.

Attention is again called to the fact that the Arbitration Committee will not consider questions under the Rules of Interchange unless submitted in the form of Arbitration Cases as per Rule 123.

Freight Car Rules

All recommendations for changes in the Rules of Interchange submitted by members, railroad clubs, private car owners, etc., have been carefully considered by the Committee and, where approved, changes have been recommended.

Rule 2

The committee recommends that the second paragraph of this rule be modified as follows:

Proposed Form—Empty cars offered in interchange must be accepted ***providing they conform to the requirements of Rule 3 and are*** in safe condition and serviceable for some commodity that can be loaded in the car, the receiving road to be the judge.

Reason—To clarify the intent of the rule.

Rule 3

The committee recommends that the effective date of the second paragraph of Section (a) be extended to August 1, 1929.

Reason—To provide for cars contracted for prior to January 1, 1929, delivery of which will not be completed by June 1, 1929.

The committee recommends that the fourth paragraph of Section (a) be modified, and the fifth paragraph be modified and the effective date extended to January 1, 1935, as follows:

Proposed Form—(4) Axles, A. R. A. Standard, required on all cars, ***except cars of 70,000 lb. capacity, built prior to October 1, 1915.*** In interchange.

(5) Axles, A. R. A. Standard, required on all cars, ***including those of 70,000 lb. capacity,*** effective ***January 1, 1935.*** In Interchange.

Reasons—The few remaining non-A. R. A. standard axles of other than 70,000 lb. capacity do not justify any extension of the time limit. Such non-A. R. A. standard axles (of other than 70,000 lb. capacity) will be gradually replaced with A. R. A. standard axles at the expense of the car owner, on the basis of Rule 86, Section (b).

With regard to the 70,000 lb. capacity axles, non-A. R. A. standard, in view of the considerable number of cars so equipped, it is desirable to grant the extension of five years, with the understanding, however, that in the interim the substitution of A. R. A. standard 60,000 lb. capacity axles by foreign roads will not constitute improper repairs.

The committee recommends that the sixth paragraph of Section (a) be modified, as follows:

Proposed Form—(6) Axles must be of not less capacity than required by the sum of the light weight and the *load limit markings* of the car, on all cars. In interchange.

Reason—To clarify the intent of the rule.

The committee recommends that the effective date of the sixth paragraph of Section (b) be extended to January 1, 1931.

Reason—The present situation justifies this extension. However, it is the intent that no further extension of this requirement will be granted.

The committee recommends that a new seventh paragraph be added to Section (b) of this rule, to be included in the next supplement issued, as follows:

Proposed Form—(7) ***Brake beam hangers and brake beam hanger pins conforming to A. R. A. Standard required on all cars built new, or rebuilt, on or after January 1, 1930. From owners.***

Reason—As recommended by the Committee on Car Construction.

The committee recommends a new eighth paragraph to Section (b), to be included in the next supplement issued, as follows:

Proposed Form—(8) ***Brake beam hangers designed with eyes which are not formed solid, prohibited, effective January 1, 1933, on all cars. From owners.***

Reason—The open eyes on brake hangers contribute to failures.

The committee recommends a new ninth paragraph to Section (b), to be included in the next supplement issued, as follows:

Proposed Form—(9) ***Brake levers: Metal badge plate meeting A. R. A. requirements and fastened to the underframe in an accessible location near air brake markings, showing dimensions of brake levers standard to the car, required on all cars built new or rebuilt on or after August 1, 1929. Effective January 1, 1933, the foregoing requirements will also apply to all cars. From owners.***

Reason—As recommended by the Committee on Brakes and Brake Equipment and approved by letter ballot.

The committee recommends that Section (d) of this rule be modified, as follows:

Proposed Form—(d) Draft key retainer, A. R. A. standard, or approved equivalent, required on all cars built new or rebuilt on or after March 1, 1929. *Effective January 1, 1931, the foregoing requirement will also apply to all cars built prior to March 1, 1929.* From owners.

Reason—Because of the inefficiency of plain and U-shaped cotter keys, now in use.

The committee recommends that the effective date of the first paragraph of Section (f) be extended to January 1, 1931.

Reason—The present situation justifies this extension.

The committee recommends that the second paragraph of Section (f) be modified and the effective date be extended to January 1, 1931, as follows:

Proposed Form—(2) Flat cars built new or rebuilt on or after July 1, 1928, must be equipped with stake pockets 4 in. wide by 5 in. deep. Effective *January 1, 1931,* the foregoing requirement will also apply to all flat cars built prior to July 1, 1928, *except that a tolerance of 1/4 in. in either dimension will be permitted.* From owners.

Reason—This variation in dimensions of stake pockets on existing cars is warranted. The present situation justifies extension of the effective date of the requirement.

The committee recommends that a new third paragraph be added to Section (r), to be included in the next supplement issued, as follows:

Proposed Form—(3) ***Refrigerator cars, having hatch covers secured by chain, will not be accepted on or after January 1, 1930, if the chain is of such length as will permit the cover to project beyond the side of the car. In interchange.***

Reason—As a safety measure.

The committee recommends that the first paragraph of Section (t) be modified, a new second paragraph added, and the present paragraphs 2 to 9 renumbered 3 to 10 inclusive, to be included in next supplement issued, as follows:

Proposed Form—(1) Trucks, new, when applied to *any* car on or after October 1, 1929, shall be equipped with cast-steel side frames conforming to *current* A. R. A. sepcifications, ***and shall have the month and year manufactured, also the letters "A. R. A.," followed by the year date of specification, cast on the outer face.*** From owners.

(2) ***Trucks, secondhand, when applied to car bodies built new or rebuilt on or after January 1, 1930, shall be equipped with cast-steel side frames. From owners.***

Note.—Cast-steel side frames on such secondhand trucks should preferably comply with current A. R. A. specifications, but existing cast-steel side frames of other design and specification may be used. However, when same are replaced with new cast-steel side frames, by car owner, such new frames shall comply with current A. R. A. specifications.

Reason—To prohibit the use of arch bar trucks under cars built or rebuilt, or new bodies built, on or after January 1, 1930; and to prohibit the use of cast-steel side frames not conforming to current A. R. A. specifications on trucks or complete cars built new on or after October 1, 1929; also, to permit the wearing out in service of existing cast-steel side frames.

The attention of car owners is called to the desirability of having all trucks equipped with cast-steel side frames conforming to current A. R. A. specifications, at the earliest date practicable. To expedite the progress of this work it is suggested that in the renewal, by the car owner, of cast-steel side frames, or top and bottom arch bars in pairs, cast-steel side frames conforming to current A. R. A. specifications be used. This will be recommended to the Association for adoption as recommended practice.

The foregoing recommendations have the concurrence of the General Committee and the Committee on Car Construction.

The committee recommends that the effective dates of paragraphs four, five and six of Section (t) be extended to January 1, 1931.

Reason—The present situation justifies these extensions.

The committee recommends that the first paragraph of Section (u) be modified, as follows:

Proposed Form—(1) Underframe, steel *having* center sills with a minimum cross sectional area of 24 sq. in. between the draft back stops, *required* on all cars (other than tank cars) built new on or after January 1, 1927, or rebuilt on or after July 1, 1928. From owners. A tolerance of one square inch below minimum will be considered as meeting this requirement.

Reason—To clarify the intent of the rule.

The attention of the Arbitration Committee has been called from time to time to various types of cars purporting to be of steel underframe construction, with a request for advice as to whether or not such types of construction meet the requirements of Rule 3, Section (u), paragraph (1). Your Committee's definition of a steel underframe, as contemplated in this requirement of Rule 3, is an underframe not dependent upon truss rods for support, having steel center sills with a minimum cross sectional area of 24 eq. in., steel body bolsters and steel cross bearers, suitably tied together. If end sills or side sills are used, they must also be of steel.

Rule 4

The committee recommends that the second paragraph of this rule be modified, as follows:

Proposed Form—Defect cards shall not be required for any slight damage (new or old), that of itself does not require repairs. ***In this connection defect cards shall not be required for the following items unless damaged to the extent shown:***

Refrigerator cars.—When sheathing is split or broken, or when raked into wood.

Other house cars.—When sheathing is split or broken, or when raked into tongue.

All cars.—Roof boards broken at ends, to any extent.

Box, stock and refrigerator cars, single-sheathed.—When metal posts or braces are bent to the extent of being out of alinement with sheathing or bolt holes.

All cars.—Metal end sill only, when straightening of same is necessary for proper operation of uncoupling apparatus, or dumping device, or to restore safety appliances to original alinement.

Reason—To conform to Decision No. 1516 and clarify the intent of the rule.

The committee recommends that Interpretation No. 2 to this rule be modified effective August 1, 1929, as follows:

Proposed Form—(2) Q.—Many bad order cars are being shipped to contract shops for repairs; are such cars subject to interchange defect carding in connection with movement over intermediate roads?

A.—In the case of a bad order car shipped, under regular billing, to a contract shop or other repair plant, *for repairs*, if moving over an intermediate road, such intermediate road is not responsible for any defects unless there is conclusive evidence of unfair usage defects having originated on the intermediate road.

In addition to the regular billing, such cars shall be side-carded on both sides, showing the name of the railroad or company forwarding the car, originating point, date forwarded, route, destination, car number and initials, purpose for which forwarded, such as "for repairs," and the name of the inspector or other representative.

Reason—For the guidance of inspectors at interchange points and to expedite the handling of such cars.

Rule 5

The committee recommends that the third paragraph of this rule be modified, as follows:

Proposed Form—Any road making partial repairs of defects on a car which are covered by a defect card will have the defects repaired crossed off the original card with ink or indelible pencil and the card replaced on the car. A copy of the card accompanying the bill with the defects which were not repaired crossed off will be sufficient authority to bill. *If defects covered by a defect card are not repaired, the defect card must not be removed until the car is withdrawn from interchange service.*

Reason—To eliminate repeated defect carding for the same defects.

Rule 7

The committee recommends that the first three paragraphs of this rule be made new first two paragraphs and modified, and the last paragraph of the rule be eliminated, as follows:

Proposed Form—When repairs are made to a foreign car (except as otherwise provided in Rule 108), or to any car on the authority of a defect card, *the original record of repairs shall be written at the car on a billing repair card, as per forms shown on pages 211, 212, 213 and 214, the carbon copy of which will serve the purpose of the original record of repairs as well as a record repair card.*

An alternate form, as shown on page 210, may, however, be used for an original record of repairs, from which the billing repair card shall be made, in which case the billing repair cards must check with the original records of repairs in so far as they should properly check as regards the details of charges. This *alternate* form embodies the minimum information required for the proper preparation of billing repair cards. Additions may be made to this form and its size made to suit the requirements of any company. This form of original record of repairs may be in book form if so desired. A card similar to the *alternate form* in its essential requirements, upon which repairs to more than one car may be recorded, may be used for recording minor repairs made in transportation yards.

Reason—The preparation of the combined billing repair card and of the original record card at the car is recommended as an economical proposition.

The committee recommends that the third paragraph of Section (2) of this rule be modified, effective August 1, 1929, as follows:

Proposed Form—The number and size of bolts, and purpose for which they are used, must be shown upon the original record; the weights need not be shown. Nuts, *when chargeable*, must be specified, except those used on bolts renewed, in which case an average of one nut per bolt will be assumed as used, regardless of whether double nuts are used.

Reason—Because of the revision of Rule 108.

Rule 9

The committee recommends that the first sentence of this rule be modified, and that the three requirements following items "Wheels and axles, R. & R." and "Brake beams, R. & R." be eliminated, as follows:

Proposed Form—The following *additional* information must be specified on billing repair cards.

Reason—It is necessary to specify the reason for all items of repairs, per Rule 8.

The committee recommends that Interpretation No. 1 to this rule be eliminated, and that the requirement for "length" of axle on wheel and axle forms shown on pages 213 and 214 also be eliminated.

Reason—The change in form will obviate the necessity for the interpretation.

Rule 17

The committee recommends that Section (d) of this rule be eliminated.

Reason—Because of the revision of Rule 104 for better reference.

The committee recommends that in the first paragraph of Section (e) the word may be changed to shall.

Reason—The A. R. A. No. 1 beam is obsolete.

The committee recommends that Section (j) of this rule be eliminated, and new Rule 83 added, effective August 1, 1929, as follows:

Proposed Form—Rule 83. The application of cast-iron wheels (*irrespective of date cast*) of nominal weight less than 650 and 700 lb.; *as well as those* cast after June 30, 1924, of nominal weight less than 750 lb.; is prohibited *on or after August 1, 1929.*

Reason—To prohibit the application of old light weight wheels, such as the 585, 600, 625 or 675 lb. wheels, which are unsuitable in modern high-speed service, as recommended by the Committee on Wheels, and to locate this requirement with other general rules on wheels.

If this recommendation is approved, your Committee will formulate a requirement that such light weight wheels, when removed from service, shall be credited as scrap, similar to the principle of allowing scrap credit on wheels condemned by the remount gage.

The committee recommends that Interpretation No. 24 to this rule be eliminated, effective August 1, 1929.

Reason—Because of the revision of Rule 108.

Rule 23

The committee recommends that the item of "tie bars" be added to Section II of this rule, under which welding of cracks and fractures will not be permitted.

Reason—It is not considered good practice to weld these parts.

Rule 26

The committee recommends a new last paragraph to this rule, to be effective August 1, 1929, as follows:

Proposed Form—In the renewal of arch bars or tie bars, all box and column bolts must be of at least the dimensions shown on Plates 3 and 4. A nut lock, which shall be of soft steel, preferably copper bearing, and not less than 3/32 in. thick, is required under the bolt head and also under the nut on the box and column bolts, to prevent the bolt from turning, regardless of whether a unit nut, lock nut or common nuts are used.

Reason—As recommended by the Committee.

Rule 32

The committee recommends that the fifth paragraph of this rule be modified, as follows:

Proposed Form—Removing or cutting out parts of a car to facilitate loading or unloading, except in the case of holes bored, drilled or punched in the sides, ends or bottoms of gondola cars for the purpose of securing lading in accordance with the Loading Rules. *When brake shafts (including their attachments), are removed to facilitate loading or unloading, the company replacing the same will assume the expense of such replacement, except where the same are missing from the car (in twin or triple shipments), in interchange, in which case the delivering line is responsible for the same.*

Reason—To definitely cover the responsibility in such circumstances.

The committee recommends that Section (a) be modified, as follows:

Proposed Form—(a) Derailment. *This responsibility also includes failure of the part causing derailment. The same responsibility also applies in case of a car body, either or both ends, dropping down on the rails or ground, or body turning over on its side, due to failure of sills or other parts, these conditions being considered the same as a derailment. The same responsibility also applies to other cars in the same cut or train even though such other cars may not have been derailed.*

Reason—Because of the difficulty of correctly determining the part that actually caused the derailment, it is advisable to include such part in the responsibility. The remaining revisions are in accordance with previous arbitration decisions and present Interpretation No. 3 to this rule, which will be eliminated.

The committee recommends that paragraphs one and two of Section (d) be modified, as follows:

Proposed Form—1. Misplaced switches, *if a car is damaged to the extent shown in Rule 44.*

2. Wrong or misinterpreted signals or failure to give or to observe signals, *if a car is damaged to the extent shown in Rule 44.*

Reason—To clarify the intent of the rule.

The committee recommends that the fourth paragraph of Section (d) be modified, and Interpretation No. 11 eliminated, as follows:

Proposed Form—4. *Impact, where* damaged to the extent shown in Rule 44, *if due to:*

No rider protection when necessary,

or

Failure of rider to properly control moving cars, or

Handling a car (*under* rider protection) *with* defective or inoperative hand brake rigging,

provided one or more of the first three cars of either standing or moving cut is damaged to the extent referred to.

Reason—For better reference and to eliminate Interpretation No. 11.

The committee recommends that the present paragraph five of Section (d) be renumbered as paragraph six, that the present Interpretation No. 4 be eliminated, and that a new paragraph five be added, as follows:

Proposed Form—5. *Application of air brakes by the manipulation of the conductors valve in the caboose, back-up hose, angle cock, disconnecting air hose for such purpose, or any such manner of manipulation causing application of the air brakes other than from the engine cab, if a car is damaged to the extent shown in Rule 44.*

Note.—The car owner is responsible for damage caused by emergency application of air brakes from the engine cab or due to the bursting of an air hose, breakage of a coupler knuckle, coupler pulling out, or any other such failure, except as otherwise provided in the Leading Rules, Sections (a), (b), (c), (g) and (o).

Reason—This provision conforms to the intent of Interpretation No. 4 and eliminates same.

The committee recommends the addition of a new note following the last item of Section (d), and the elimination of Interpretation No. 3, as follows:

Proposed Form—Note.—The responsibility for combination damage, per Rule 44, also includes any damage to adjoining cars, in consecutive order, in the same draft or train.

Reason—To eliminate Interpretation No. 3.

The committee recommends that Section (m) be modified, as follows:

Proposed Form—(m) Storm where car is *damaged due to being struck by flying debris, or where damaged to the extent of Rule 44.*

Reason—To more definitely cover the responsibility.

The committee recommends that Section (o) be modified, as follows:

Proposed Form—(o) Telescoping the superstructure above the sills due to mounting *by* an adjacent car. This provision has no bearing on responsibility for failure of the adjacent car.

Also, end of car body above the underframe, broken or bent *inwardly,* when not associated with the failure of the *end sill* (*on cars so equipped*) on the same end.

Reason—To clarify the intent of the rule.

Rule 44

The committee recommends that Section (4) of this rule be modified, as follows:

Proposed Form—(4) All longitudinal sills on all-steel underframe cars having but one steel center member; *except when failure of such center member, back of the body bolster, is due to progressive fracture or due to the failure of the cast-steel extension (draft arm), owner will be responsible, providing after investigation it is found that the car was not subjected to unfair handling as provided by Rule 32.*

Reason—This type of center sill construction is developing inherent weakness, as evidenced by the fact that sills under a large number of cars require re-inforcement, and in the circumstances it is only fair that owners shall be held responsible for failures due to such a cause.

The committee recommends that Section (5) of this rule be modified, as follows:

Proposed Form—(5) Two steel center sills on all-steel underframe cars having but two longitudinal sills; *except when the damage is confined to the sills between the end sill and body bolster, the owner will be responsible, providing after investigation it is found that car was not subjected to unfair handling as provided by Rule 32.*

Reason—The situation is such as to justify this exception. The principal conditions were covered in detail in the 1925 annual report of the Arbitration Committee.

Rule 58

The committee suggests that this rule be modified, as follows:

Proposed Form—Missing brake cylinders, reservoirs, triple valves, pressure-retaining valves, release valves, cut-out cocks, angle cocks or air hose, each or all complete.

Reason—Because it is impracticable to inspect for these details in interchange. Also, in view of the interior parts being included in the average charge for cleaning air brakes, it being impracticable to follow up the individual triple valve at the test rack to ascertain the defects.

The committee recommends that a new last paragraph be added to this rule, and that the present Interpretation No. 2 be eliminated, as follows:

Proposed Form—In the event of air brakes being cleaned, due to inoperative conditions, within nine months from the date of the last previous cleaning, the car owner is responsible, except under the following conditions:

If the brakes are cleaned within sixty days from the date of the last previous cleaning by the same road, charge for such subsequent cleaning is not permissible, except where the subsequent cleaning was occasioned by a broken brake cylinder, triple valve body, or check valve case, account owner's responsibility. If cleaned on different roads or private car lines within sixty days from the date of the last previous cleaning, the entire charge for such previous cleaning, according to items 18, 23 and 29, Rule 111, shall be withdrawn, except where the last cleaning was occasioned by delivering line defects, or account of a broken cylinder, triple valve body or check valve case, owner's responsibility. Where last cleaning is done by the car owner, joint evidence per Rule 12 shall be used to establish the defective condition which occasioned such cleaning.

In case the brakes are not cleaned in connection with the renewal of a brake cylinder, triple valve body or check valve case broken, account of owner's defects (where the brakes are not due for periodical cleaning), the charge shall be confined to such renewal of brake cylinder or triple valve body; no

charge for the renewal of a removable valve case, as the same is included in Item 29, Rule 111.

Renewal of a defective air reservoir of itself does not justify cleaning of the air brakes within the nine months time limit.

Reason—To more definitely cover the requirements and eliminate present Interpretation No. 2.

Rule 61

The committee recommends a new Rule 61, to be effective August 1, 1929, as follows:

Proposed Form—Owners responsible:

Rule 61. Brake beam hangers of round or other section, originally less than one inch in diameter, or equivalent, if the vertical thickness of any portion of the hanger is reduced to 5/8 in. or less.

Brake beam hangers of round or other section, originally one inch or more in diameter, or equivalent, if the vertical thickness of any portion of the hanger is reduced to 3/4 in. or less.

Brake beam hanger pins or bolts, originally one inch or less in diameter, if worn to 3/4 in. or less at any point.

Brake beam hanger pins or bolts, originally in excess of one inch in diameter, if worn to 7/8 in. or less at any point.

Brake beam head, supported from the top hanger eye, if the vertical thickness of the top portion of the eye of such brake head is worn to 7/16 in. or less.

Brake beam hanger bracket cast integral with the truck side or bolster, having the pin hole worn oblong to a depth of one-half its original diameter, shall be restored to its original diameter by bushing or by autogenous welding process. If the hanger bracket is not cast integral with the truck side or bolster, it shall be renewed when the pin hole is worn to the extent specified above.

Reason—This recommendation has the concurrence of the Committee on Car Construction.

Rule 65

The committee recommends that this rule be modified, as follows:

Proposed Form—Missing journal bearings; journal bearings (regardless of previous condition). *journal wedges,* journal-box bolts and dust guards which require renewal, when delivering company is responsible for change in wheels and axles.

Reason—To definitely indicate the responsibility for journal wedges in connection with wheels exchanged because of delivering line defects.

Rule 66

The committee recommends that the effective date which makes the owners responsible for periodical repacking of journal boxes be extended to January 1, 1930.

Reason—As authorized by the General Committee and announced in Circular D.V.-619, issued February 21, 1929.

The committee recommends that Sections (a), (f) and (g) of this rule be modified, as follows:

Proposed Form—(a) Periodic repacking of journal boxes, after the expiration of twelve months, as indicated by the stenciling on car, regardless of the responsibility of handling company for change of wheels or other repairs. *After the expiration of nine months, if the car is on repair track for other work, journal boxes may be repacked at the same time.*

(f) This work shall be done only when cars are on the repair track. *After the expiration of nine months from the last repacking date, the work may be done when the car is on a repair track for other work.* The billing repair card shall *in such cases* specify the purpose for which car was shopped.

(g) No charge shall be made for repacking, etc., if performed within twelve months from the date stenciled on the car; *except when the car is on a repair track for other work after the expiration of nine months, charge for repacking is permissible if performed at the same time.*

Reason—Periodic repacking of journal boxes should, so far as practicable be on the same time basis as air brake cleaning.

Rule 70

The committee recommends that Interpretation No. 1 of this rule be modified, effective August 1, 1929, as follows:

Proposed Form—(1) Q.—Can you apply a wrought-steel or cast-steel wheel in place of a cast-iron wheel and charge the owner for the betterment?

A.—No.

Reason—The 850 lb. cast-iron wheel is now recommended practice of the American Railway Association and should receive the same protection as other recommended practice cast-iron wheels.

Rule 76

The committee recommends that the first paragraph of this rule be modified, as follows:

Proposed Form—Tread worn hollow—cast-iron and cast-steel wheels: If the tread is worn so that the projection on the under side of the gage does not come in contact with the tread of the wheel (see Fig. 4-D). See paragraph 110 and Fig. 92 in Wheel and Axle Manual.

Reason—To confine the condemnation of wheels because of the tread worn hollow to those which will take the gage shown in Figure 4-D, thus eliminating the judgment feature, as recommended by the Committee on Wheels.

Rule 81

The committee recommends that this rule be modified, and interpretation following the same be eliminated, to be effective August 1, 1929, as follows:

Proposed Form—Rule 81.—Loose—any wheel. *The same responsibility applies to wheels removed from service account of indications of being loose on the axle due to oil seepage from inside of the wheel fit. See paragraphs 116, 140, 142, 218 and 240 of the Wheel and Axle Manual.*

Out of gage—any wheel (see Fig. 9)—*If the pair of wheels is removed from service account of this defect, where no other condemnable defect exists on wheels or axles.*

Car owner, however is entitled to protection on the basis of wrong repairs for these conditions (loose, oil seepage or out of gage), providing that the wheel is removed within one year from the date of application.

Reason—The present situation justifies this provision in connection with the principles indicated in the Wheel and Axle Manual, as recommended by the Committee on Wheels.

Rule 84

The committee recommends that this rule be modified, as follows:

Proposed Form—Rule 84. Journal cut, *or requiring reconditioning due to heating;* axles bent; or axles damaged as provided in Rule 32.

Reason—To clarify the intent, as per Decision No. 1601.

Rule 86

The committee recommends that Sections (a), (e) and (f) of this rule be modified, as follows:

Proposed Form—(Vacant. Limits of wear for the non-A. R. A. Standard 70,000 lb. capacity axle to be added to the table of A. R. A. standard axles.)

(a) Axles must be removed from service when less than the limits prescribed in columns "C," "D" and "E," or when the condemning limits in columns "F" and "H" are reached, *as shown in table under this rule.*

Cars may be loaded to the limits shown in column "A" (which is the total weight of car and its lading for the respective capacities), on basis of four axles per car, except where stenciled load limit has been reduced, as indicated by star (*) symbol per Rule 30, account structural limitations on car body or trucks.

All cars to have their light weight and capacity in pounds stenciled on them, as per Section (s), Paragraph 3, Rule 3. Load limit markings *are* also *required on all cars, except tank cars and live poultry cars,* as provided in Rule 30.

(e) (Vacant.)

(f) The use of A. R. A. standard axles, with wheel seats not more than 1/8 in. in excess of standard diameter, is permissible for remounting secondhand wheels.

Reason—The limits of wear for A. R. A. standard axles will properly apply to the few remaining non-A. R. A. Standard axles of other than 70,000 lb. capacity; the second paragraph of Section (b) also applies.

The committee recommends that the following sentence be added to the second paragraph of Section (b):

Proposed Form—This provision does not apply to the non-A. R. A. 70,000 lb. capacity axle; however, the substitution of A. R. A. standard 60,000 lb. capacity axle for non-A. R. A. standard 70,000 lb. capacity axle, where the latter is standard to the car, will not constitute improper repairs.

Reason—The conditions are such as to justify this substitution, by foreign roads, without incurring responsibility for improper repairs. Under the present rules the approximate difference in charge for replacing the 60,000 lb. capacity axle with 70,000 lb. capacity axle, because of improper repairs, is only $1.50 per axle.

The committee recommends that the time limit be removed from the last paragraph of Section (b).

Reason—Time limit is eliminated because of the changes in Rule 3, Section (a), Paragraphs 4 and 5.

The committee recommends that the second paragraph of Section (d) of this rule be modified, as follows:

Proposed Form—If the *car* owner *removes* an A. R. A. standard axle (*on authority of a defect card*), and *applies a 70,000 lb. capacity non-A. R. A.* standard axle, he shall charge the average *secondhand value* for the non-A. R. A. standard axle, and *allow* credit for the value of the A. R. A. standard axle removed as a secondhand or scrap axle, as covered in the limits above, at the prices *shown* in Rule 101.

Reason—To more definitely cover the proposition.

The committee recommends a new section be added to this rule, to be new Section (e) in place of present Section (e) eliminated above, and that the present Interpretations 2 and 3 be eliminated, as follows:

Proposed Form—(e) *A reclaimed axle which has been upset or reworked to a smaller size, if conforming to A. R. A. standard in design and maximum dimensions (except that center diameter may exceed such standard diameter), may be considered as new and so charged, for the class to which it conforms, provided it has not been previously used as such class.*

Reason—To eliminate the present Interpretations Nos. 2 and 3.

Rule 95

The committee recommends that this rule be modified, and Interpretation No. 2 be eliminated, as follows:

Proposed Form—Labor only shall be charged against the car owner for replacing the following details *in kind (or by substitution of other materials)*, when lost on the line of the company making the repairs:

Couplers, including yokes, springs and followers (any or all), when lost with the coupler; *also including yoke rivets when the yoke is lost with the coupler; except where the draft gear is in place and the coupler and its yoke is missing, material of such yoke and its rivets may be charged against the car owner.*

Friction draft gear complete, whether or not lost with the coupler; *including followers when lost with the friction gear.*

In the case of the first application of a new or secondhand type "D" coupler *in place of* missing secondhand old style coupler, *or non-A. R. A. standard coupler*, the car owner may be charged for the difference in value.

Reason—The yoke is usually defective when missing with the coupler where the draft gear is in place. Also, to clarify the intent and to eliminate Interpretation No. 2.

The committee recommends that the present Interpretation No. 1 to this rule be eliminated.

Reason—No longer justified, because of the change in the rule.

Rule 91

The committee recommends that a note be added following Section (f), as follows:

Proposed Form—Note.—With a view of effecting further economies in the cost of handling bills for car repairs, it is suggested that checking for car numbers and location be eliminated where the total charge per car is not in excess of $1.00, because it is usually found that corrected numbers are furnished or locations verified. However, this provision is not mandatory.

Reason—As an economic measure.

Rule 98

The committee recommends a new eighth paragraph to Section (b), to be effective August 1, 1929, as follows:

Proposed Form—(8) *In the event of new wheels applied, account of owner's responsibility, if the same wheels are subsequently removed on the same road, account of handling line responsibility (of same road) and replaced with secondhand wheels within fifteen days from the date of such application, or on authority of its defect card if dated within the fifteen day limit, the initial charge for the difference between new and secondhand wheels shall be withdrawn. This provision applies similarly to axles.*

Reason—The developments under the present rule justify this exception.

Rule 104

The committee recommends that the second and third paragraphs of thus rule be modified, as follows:

Proposed Form—Secondhand former standard or temporary standard couplers or parts of same shall be charged and credited at 50 per cent of value new. Credit shall be confined to the body, lock, knuckle and knuckle pin. *However, when correcting wrong repairs, scrap credit shall be allowed for such couplers and their parts where the "D" type coupler was standard to the car.*

When a new coupler is applied it shall be so charged whether or not it is of same make as that removed; *except where the car owner removes an A. R. A. type "D," former A. R. A. standard or temporary standard coupler, on account of wrong repairs, charge for the coupler applied will be confined to second-hand value.*

Reason—Because of the elimination of Section (d) of Rule 17 and to provide a more equitable adjustment for the car owner.

Rule 108

The committee recommends the addition of the following items to Section (a), for which no labor charge may be made; to be effective August 1, 1929:

Brake staff stirrup or support, straightened on car.

Release lever direct connection, all types, connected up and closed, when out of eye at top of knuckle lock lifter or at lever.

Reason—It is desirable to include these items.

The committee recommends the elimination of the fifth item, reading "*Brake beam truss rod nuts; applied, when beam is not removed from car,*" from Section (a) of this rule.

Reason—Because of the confliction with Interpretation No. 12 to Rule 107.

The committee recommends the addition of the following items to Section (b), for which no labor or material charge may be made; to be effective August 1, 1929:

**Nuts, nut locks and lock nuts (including unit nuts), all types, 1⅛ inches or smaller.*

**Note.—This provision has no bearing on the fact that the average weight of bolts as shown in table under Rule 101 includes one nut; nor does it affect labor charges where other details are R. & R. or R. on bolt or nut basis.*

Reason—As an economy measure in connection with the expense of preparing car repair records and bills and to permit inspectors to properly prepare trains for movement instead of preparing records of repairs made, thereby facilitating the movement of trains through terminals and yards.

Rule 112

The committee recommends the addition of a note under Class E-4 designation in table on page 181, and also, following Item 4 on page 191, as follows:

Note.—Cars with continuous metal draft sills of not less than 18 lb. per foot per member, without cover plates, where such continuous metal draft members are suitably tied to the body bolster, are equivalent to Class E-4 for settlement purposes.

Reason—This type of construction should properly be classed as equivalent to that of Class E-4 cars, as recommended by the Committee on Car Construction.

Rule 113

The committee recommends that the first paragraph of this rule be modified, as follows:

Proposed Form—Rule 113. For the mutual advantage of railway companies interested, the settlement for a car when damaged or destroyed upon a private track, shall be assumed by the railway company delivering the car upon such track; *except in the case of a private car damaged or destroyed by or resulting from fire or explosion, or some other condition beyond the control of the delivering line, on private tracks belonging or leased to the car owner, or while located on the private tracks of a car manufacturing or repair plant under arrangement between the car owner and the car manufacturing or repair plant.*

Reason—To more properly cover the situation on the basis of the general principles of the Interchange Rules.

Rule 123

Attention is directed to Arbitration Decision No. 1493, printed in Circular No. D. V.-499, issued December 31, 1926, an ex parte case. The decision of the Arbitration Committee was not considered as final and binding by the defendant and the case was therefore submitted to the Circuit Court of Peoria County, Illinois, for adjudication, and judgment secured contrary to the decision of your Committee under the Interchange Rules. The case was then appealed to the Appellate Court of Illinois, which Court reversed and remanded the judgment of the Circuit Court. The judgment of the Appellate Court, therefore, sustains the principle laid down in previous court rulings, that a decision of the Arbitration Committee of the Mechanical Division, American Railway Association, under its rules, is binding upon all subscribers thereto.

Passenger Car Rules of Interchange

Rule 7

The committee recommends that the first and second paragraphs of Section (f) be modified, effective August 1, 1929, as follows:

Proposed Form—(1) Loose—*any* wheel.—*The same responsibility applies to wheels removed from service account of indications of being loose on the axle due to oil seepage from inside of the wheel fit. See paragraphs 116, 140, 142, 218 and 240 of the Wheel and Axle Manual. Car owner, however, is entitled to protection on the basis of wrong repairs, providing the wheel is removed within one year from the date of application.*

(2) Variations from gage—*any wheel* (see Fig. 9).—*If the pair of wheels is removed from service account of this defect, where no other condemnable defects exist on wheels or axles. Car owner, however, is entitled to protection on the basis of wrong repairs, providing the wheel is removed within one year from the date of application.*

Reason—The present situation justifies this provision in connection with the principles indicated in the Wheel and Axle Manual, as recommended by the Committee on Wheels.

The committee recommends that the phrase "or rim liable to breakage," be eliminated from the first paragraph of Item (4) of Section (f).

Reason—To confine the condemnation of wheels because of the tread worn hollow to those which will take the gage shown in Figure 4-D, thus eliminating the judgment feature as recommended by the Committee on Wheels.

The committee recommends a new Section (1) be added to this rule, as follows:

Proposed Form—(1) *Effective January 1, 1930, periodic repacking of journal boxes on passenger equipment cars (irrespective of types of trucks), after the expiration of six months as indicated by the stenciling. This work to be performed as outlined in detail in Freight Car Rule 66 except as to the time period of Section (a), location of stenciling per Section (c) and the requirements of Section (f). The stenciling, as per Section (c) of Rule 66, to be located on both sides of each truck where space permits (otherwise, to be placed on both sides of the car body at the platform end sill or step side). Car owner shall be billed for this work as per Rule ——. Separate billing repair cards shall be furnished showing length of journal; number of journal boxes; name of road; date of last previous repacking, or no date, or date illegible; and work performed as per Rule 7.*

Reason—As recommended by the Committee on Lubrication and approved by letter ballot. In view of the requirement for periodic repacking it is consistent that the car owner be responsible for this expense.

Rule 8

The committee recommends that Item (1) of Section (a) be modified, as follows:

Proposed Form—(1) Derailment. *This responsibility also includes failure of the part causing derailment.*

Reason—Because of the difficulty in correctly determining the part that actually caused the derailment, it is advisable to include such part in the responsibility.

The committee recommends that Item (13) of Section (a) be modified, as follows:

Proposed Form—(13) Storm where car is *damaged due to being struck by flying debris, or where damaged to the extent of above Item (4).*

Reason—To more definitely cover the responsibility.

The committee recommends that Section (e) be modified, as follows:

Proposed Form—(e) Journal cut, *or requiring reconditioning due to heating;* axles bent; or axles damaged as provided in paragraph (a). When necessary to true up axles in cases of cut journals, if journal is reduced below the limit as prescribed in Rule 7 (e), axle must be changed at the expense of the delivering line.

No reason given.

Rule 9

The committee recommends that Section (d) be modified, as follows:

Proposed form—(d) Lubrication, labor and material; *except periodic repacking as referred to in Section (1) of Rule 7.*

Reason—Because of the change in Passenger Rule 7.

Rule 13

The committee recommends that the fourth item under Section (b) of this rule be modified, as follows:

Proposed Form—Lubrication, except cars in line service *or periodic repacking as referred to in Section (1) of Rule 7.*

Reason—Because of the change in Passenger Rule 7.

Rule 19

The committee recommends that the last paragraph of this rule be modified, as follows:

Proposed Form—The A. R. A. rules and prices covering repairs to freight equipment cars will govern in cases of repairs to cars of freight car construction, moving in passenger service, and the A. R. A. rules and prices covering repairs to passenger equipment cars will govern in cases of repairs to cars of passenger car construction moving in freight service, *except as follows:*

Cars of freight car construction, equipped with passenger car trucks, *shall be subject to* A. R. A. rules and prices covering repairs to passenger equipment cars in the case of repairs to such trucks, irrespective of the kind of service in which the car is used.

Cars equipped for passenger train service, having freight car trucks, shall be subject to the A. R. A. rules covering repairs to passenger equipment cars (except as to the time allowances for labor), in case of repairs to such trucks, irrespective of kind of service in which car is used.

Reason—Freight trucks under cars in passenger train service should be subject to the passenger car rules with regard to condemning limits for wheels, application of passenger brake shoes, etc.

Discussion

Mr. Demarest: The Arbitration Committee, contrary to your opinion perhaps, has two sub-committees connected with it. There is a sub-committee on cost of car repair billing, and one on investigation of the cost of preparation of bills for minor repairs to foreign cars. I am taking this occasion to call your attention to the valuable work done by those two sub-committees. If there is any credit for this report it belongs to the sub-committees.

It is costing you, according to the best information your committee has been able to obtain, something over three million dollars a year to prepare and collect bills. While we are trying to save money, and we are all doing that, we have not finally got to the end of the problem yet.

In consulting with the Wheel Committees, your Arbitration Committee proposed a change in Rule 83. In other words, we propose the absolute prohibition of light weight gray iron wheels. Your Wheel Committee and your Arbitration Committtee felt at that time that they were justified in presenting that recommendation to you, but since then it has been called to our attention that on some roads, due to practices which have existed until very recently, there are a tremendously large number of these light wheels, and that it would be a hardship to impose a hard and fast regulation at this time. Therefore we suggest an amendment to the proposed rule, the addition of the following words: "On and after January 1, 1931."

Your committees feel that it is wise to make this amendment, because it will give the Wheel Committee and the Arbitration Committee another year to study the general situation, and with that amendment, there will be no hardship imposed on any railroad in the interim.

There is one other item also in connection with the pivot butt coupler and the bottom rotary coupler. The situation in respect to the handling of these two devices will be taken care of in the rules, provided the owner desires to pay freight on the returned material if it is removed, the material to be returned to the owner at his own expense. I would like to add those two additional features to the report of the Arbitration Committee.

G. S. Goodwin (C. R. I. & P): There is one question I want to ask about Section U, Rule 3. I have in mind an underframe that meets the requirements of Para. U exactly, but it does use or continue the truss rods under the side sills, and the intermediate sill when it is used. The underframe has nine or ten underchannels with a 3/8-in. copper plate. It has the bolsters under it. It has the needle truss under it but no side sills.

I want to ask Mr. Demarest if this definition of an underframe would bar that underframe and make it just a steel center sill.

Mr. Demarest: Your Arbitration Committee, from time to time, has had variations in underframes presented to it, with the request to be advised whether or not the type, as presented to it, constitutes a steel underframe. It seemed wise to avoid further question and to incorporate in the rules a definition of what constituted a steel underframe. After consulting with the Car Construction Committee, your Arbitration Committee has presented this definition to you. In its opinion, a steel underframe, to constitute a steel underframe, must be and provide in itself sufficient strength not to require the application or connection of truss rods to support it.

Mr. Goodwin: The point I want to make is, would it require truss rods to support the car, or to support the underframe?

Mr. Demarest: In my opinion, yes.

Mr. Goodwin: That answers my question.

Mr. Kleine: On account of the most excellent work of our Arbitration Committee, I hesitate even to make a suggestion for a change in any rule. However, without changing the principle at all in the rule, I believe that the change in Rule 66, proposed by the Arbitration Committee should be adopted for the present. It refers to the periodical repacking of journal boxes, by permitting roads to repack journal boxes on foreign cars after the expiration of nine months. We are all interested in getting this rule into effect, and most all of the roads are getting their journal boxes repacked, but I do not consider it essential that we should add that nine-month period. I should like to ask your Arbitration Committee whether it is willing to delete that portion from the report.

Mr. Demarest: In answer to Mr. Kleine, the Arbitration Committee had this thought in mind. In the first place, you permit the cleaning of air brakes at the nine-month period provided the car is on the repair track for other work. Your committee asked itself why you should limit that type of extra work, if you so call it, to the air brake cleaning? Why not at the same time, while the car is on the repair track for other work, permit the repacking of the journal boxes instead of waiting for the full twelve-month period. We are all interested, and I am sure Mr. Kleine is also, in maintaining journal boxes in a properly packed condition; delays to freight trains on that account cost a very considerable amount of money. Therefore, it may be advisable to permit the repacking of boxes ahead of the twelve-month period, providing the car is on the track for other work, and providing nine months time has expired.

It makes the air-brake cleaning and your journal-box packing go together.

Mr. Kleine: I don't believe that it is proper to associate the journal box repacking with the air brake cleaning. You may wish to do that on your own tracks, and that would be perfectly proper, but it means increasing the frequency of journal box packing. It takes it out of the hands of the car owner to give his boxes periodical attention within a year. If it is in order, I would like to make a motion that the nine-months period for repacking of journal boxes as included in Rule 66, be eliminated.

Chairman Smart: Does anyone second that motion?

Mr. Demarest: I will second the motion, but I would like to say a word.

Chairman Smart: All right.

Mr. Demarest: I would like to ask Mr. Kleine and the members here whether they think it is economical. Your car owner, of course, has the privilege of repacking journal boxes any time, anywhere. I am certain that Mr. Kleine does not have in mind that he wants to let the car run twelve months, and then shop it out specifically for journal box packing. I think that if, prior to that time, you have the car on the repair track for some other work, while it is there it is an economical operation to do your journal box packing and avoid the necessity of shopping your car later, simply because it is overdue for journal box packing.

Mr. Kleine: In answer to Mr. Demarest, I may say that we have about 272,000 freight cars, and the time limit of one year is pretty close, in order to get over the lubrication of the boxes. The charge when a foreign road does the work is pretty heavy, and that is the only reason that I am asking that the change be made in the report.

Mr. Nystrom: I believe that all railroads are confronted with the same problem. I am thoroughly in accord with the Arbitration Committee to have the period coincide with the air brake cleaning. In fact that will conform with the spirit of the rule, as I understand that the journal box packing should be done when the car is on the repair track for other work. Am I

right about that?

Mr. Demarest: Yes.

Mr. Nystrom: At present, no railroad can well afford to mark out cars for journal box packing only, and I believe that to have a limit from nine months up that it will be economical. I hope to see the time when we can add to this list the inspection of draft gears, all to be done at the same time.

Chairman Smart: There is a motion before you gentlemen. Are you ready for the question?

The motion was put to the convention and lost.

Vice-Chairman Ayers: I want to raise a question in line with what the chairman of the Arbitration Committee talked about in connection with the cost of billing. I hope that in their investigation of the cost of billing they may be able to develop what kind of work is to be billed for. What I have in mind is this. The Car Construction Committee and other committees as well are recommending a great many improvements in details, and there is a question in my mind, how far those improvements are actually being applied in practice. During the past winter I think most everybody had some pretty hard experiences in the way of accidents and delays caused by defective equipment, and a casual inspection of cars in trains and yards will bring out some conditions that are not very attractive, to say the least. I can't help but have an impression that a great deal of the billing for repairs, and primarily the repairs themselves, could be avoided if car owners would apply some of these improvements in design that are being worked out. In the Arbitration Committee's report there are set forth some limits of brake hangers. That is one thing that has got into the rules. There are a multitude of other things that the car owners can do with their cars that will bring the cars up so that they can be run reliably and without interruption, and that after all is what we are trying to do toward improving railroad operation.

If the car owners will put the details in their cars in proper shape I think you will in that way avoid a whole lot of billing and get better service out of the car besides. That is not in any way contrary to anything that the Arbitration Committee has said. It is rather in support of its position that this billing is a heavy expense. I think that you can kill two birds with one stone if you will fix up the cars and keep them up to modern recommended standards.

Mr. Kleine: I move you that the report of the Arbitration Committee be accepted and a rising vote of thanks be given to the committee.

The motion was duly seconded and carried by a rising vote.

Report on Prices for Labor and Materials

A. E. Calkins
Chairman

In order that the rules may currently provide an equitable basis for inter-road billing, your Committee has continued the work on analyzing material, labor and new equipment costs in A. R. A. interchange Rules 101, 107, 111 and 112 of the freight car code, and Rules 21 and 22 of the passenger car code, with a view of determining and recommending necessary changes to be made in supplement effective August 1, 1929.

Rule 101

All miscellaneous material prices in Rule 101 were rechecked as of March 1, quotations from purchasing agents of eleven railroads, representing 39 per cent of total freight-car ownership in the United States and Canada, indicating that no changes were necessary in new or scrap prices except in the case of chain, couplers, journal bearings, dust guards, pipe, pressed or flanged steel, axles and brake beams. Because of an error in previous calculation the price of the 33-in. cast-iron wheel for 9-in. journal has also been corrected.

Items 57-P and 57-Q have been eliminated on account of being covered by Items 56 to 57-M, inclusive, showing charges and credits for various exchanges of triple valves. The wording of Item 57-N has been modified on account of an interpretation by the Arbitration Committee in regard to stenciling for triple-valve type when the car bears previous stenciling to indicate standard to the car.

In order to simplify the billing, Item 115-C has been modified to provide price applied to the car, and labor allowance omitted from Rule 107.

As a result of criticism in regard to average weights of both new and scrap journal bearings, investigation has been conducted and averages secured for the various sizes from a number of railroads, private car lines and manufacturers. As a result of data secured, revised basis is recommended for both new and scrap bearings under Items 162 to 163-F, inclusive.

Items 175, 175-B and 175-D have been eliminated, and Items 175-A, 175-C and 175-E modified, account nut locks, lock nuts and unit nuts, 1⅜ in. or less, having been added to Section (b) of Rule 108. Items 190, 190-A and 190-B have been eliminated ebcause they are covered in Rule 107.

On account of a recommendation by the Arbitration Committee for revision of Section (e) of Rule 17, to make mandatory the use of A. R. A. No. 2 or A. R. A. No. 2 plus brake beam in repairs, it is recommended that allowances under Items 209 and 212, covering the A. R. A. No. 1 and non-A. R. A. beams, be modified to restrict charge new or secondhand to average credit basis.

Seven new items covering additional types of friction draft gears are included in the table on pages 133 and 134 of the current code.

Based on data received from eleven large representative railroads as of March 1, as to daywork hourly rates paid all employes directly engaged in freight-train car repairs, the weighted average hourly rate was found to be $.6677. Adding the 61.92 per cent overhead heretofore authorized, produces $1.08 and your committee is recommending the adoption of a labor rate per hour for freight car repairs of $1.10 for the supplement effective August 1, 1929, in lieu of existing rate of $1.05 with corresponding increases in rates for tank-car and passenger-car repairs.

As a result of comments in connection with allowances under Items 169-E to 169-I, inclusive, covering the charge for periodical repacking of journal boxes, your committee will conduct time studies of the various operations involved on representative roads and private car lines, and if sufficient change develops necessary revision will be made and inserted in the Rules effective January 1, 1930.

On account of the slight variations in material markets in the past several years and in deference to those handling the interchange billing, your committee feels that material prices should be permitted to remain in effect for one year; and recommends that the committee be authorized to review general material prices annually as of March 1, instead of the present semi-annual review, changes recommended to become effective, if approved at the annual meeting, on the following August 1 of each year, unless a noticeable market fluctuation arises

which might make an adjustment desirable in the interim. It is, of course, the intention to continue the semi-annual review of labor rates.

Rule 107

The wording of Items 51-A, 84, 117, 201-A, 222-A, 254 and 377 have been modified to clarify the intent. Items 54-A and 254-A have been eliminated being covered in other items. Item 255 has been eliminated, because this operation is added to Section (a) of Rule 108.

New Item 83 is recommended to cover renewal of center-plate rivets; new Item 119-A to cover renewal of coupler yoke pins in cases where it is unnecessary to remove the coupler, new Item 122-A to provide allowance for complete coupler and gear R. & R. when necessary in connection with metal-sill repairs; new Item 217 to cover R. & R. of hinge pin or bolt, over six inches in length; and new Item 493-A to provide combination labor charge when wheels, arch bars, truck bolster and spring plank are R. & R. or R. at the same time.

In accordance with the recommendation for an increase of hourly labor rate in Rule 101, Item 442 is increased from $1.05 to $1.10 per hour.

The committee also recommends that the $1.20 hourly rate covering repairs of steel tanks of tank cars, as shown in Item 443, be increased to $1.25.

In your committee's report to the 1927 annual meeting, when recommendation was submitted and approved to increase the hourly labor rate from $1.00 to $1.05 per hour, it was decided that no change on account of this 5 per cent increase should be made in the detailed labor allowances where they were shown in units of money instead of time. With the recommended increase in the hourly labor rate this year from $1.05 to $1.10 per hour, a total variation in these various items of 10 per cent is involved, and your committee recommends that such detailed allowances be increased accordingly.

Rule 111

Aside from revisions of the various allowances due to the increase in the labor rate, no changes are suggested at this time in the various items under this rule.

Rule 112

Recommendations are made in Rule 112 respecting reproduction pound prices of new freight-train cars of all classes in order that Supplement of August 1, 1929, may reflect 1928 costs in lieu of 1927 figures shown in the present code. The prices for refrigerator, poultry and tank cars are based on the trend which occurred in the 1928 market covering total new equipment purchases as compared with 1927. Pound prices for refrigerator, poultry and tank cars are based on figures furnished by representative roads and private lines in the United States and Canada. Prices for all other equipment represent the average selling prices set up by the Presidents' Conference Committee, which secured quotations on total output of several large U. S. car manufacturers. Figures from Canadian roads were not used as their total ownership is less than one-tenth that of U. S. carriers and the effect of including them in the weighted average would be negligible.

Class D cars have carried the same prices as Classes B and C cars under this rule since 1920. Your committee was requested to establish a separate price for Class D cars. As such cars are not being constructed new (with the exception of refrigerator cars), a study of book values was made on a member road having both Class C and Class D cars, which developed a differential price 3.93 per cent less than the Class C price. This differential has been used in establishing the proposed Class D price, based on cost of Class C cars built in 1928, and is recommended as Class D price to be made effective in the supplement of August 1, 1929, for box, hopper, coke, and all others except tank, poultry and refrigerator cars. This differential will not apply to refrigerator cars as a number of Class D refrigerators reported built during 1928 reflected costs comparing favorably with the Class C refrigerator car. In accordance with past practice, therefore, your Committee has averaged the prices for the Classes B, C and D refrigerator cars built during 1928 and recommends the same per pound settlement price as applicable to all three classes.

Passenger Rule 21

Based on increase in hourly rates reported by eleven representative railroads, your committee is recommending an increase in the labor rate per hour for passenger car repairs to $1.20, in lieu of the $1.15 now authorized in Item 20; and also an hourly labor rate for lubrication of $0.85, in lieu of the $0.82 now shown in Item 19. Various other detailed allowances have also been increased in accordance with the change in the hourly labor rate.

Passenger Rule 22

Changes in material prices of nineteen items under this rule are recommended, based on quotations as of March 1 from the purchasing agents of eleven representative roads. The price of the 33-in. cast-iron wheel for 9-in. journals has been corrected.

It is the intent of the committee to investigate labor costs again in October, and if sufficient change develops, necessary revision will be made and inserted in the rules effective January 1, 1930.

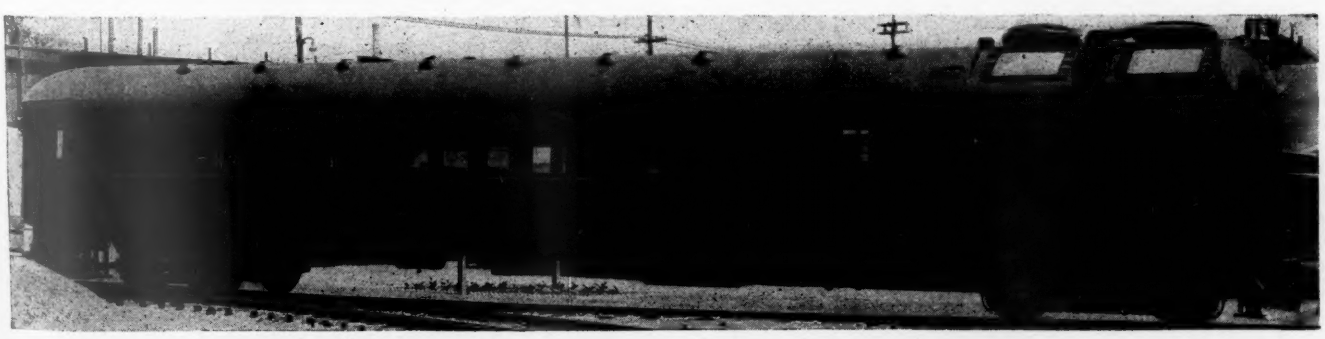
(The changes recommended in the existing rules are shown in detail on sheets which were attached to the report.—Editor).

The report was signed by A. E. Calkins (chairman), superintendent rolling stock, New York Central; Ira Everett, master car builder, Lehigh Valley; F. J. Dodds, general car inspector, Atchison, Topeka & Santa Fe; E. H. Weigman, master car builder, Kansas City Southern; P. Kass, superintendent car department, Chicago, Rock Island & Pacific; T. J. Boring, general foreman, M. C. B. Clearing House, Pennsylvania; H. H. Harvey, general car foreman, Chicago, Burlington and Quincy; H. H. Boyd, assistant chief motive power and rolling stock, Canadian Pacific; A. E. Smith, vice-president, Union Tank Car Company, and A. H. Gaebler, master car builder, Swift Refrigerator Transportation Company.

Discussion

Mr. Demarest: I move the adoption of the report.

The motion was duly seconded and carried.



Combination passenger and baggage gas-electric car built for the Pennsylvania by the J. G. Brill Company

Powered with two Brill-Winton 175 hp. engines direct connected to two Westinghouse 120-kw. generators. Total seating capacity of car, 73.

Report of Committee on Tank Cars

G. S. Goodwin
Chairman

During the year your committee handled 52 dockets by meeting, involving approximately 7,000 tank cars for which approvals had been pending and which were then granted. Since that time your committee has handled various applications involving approximately 3,500 cars, 1,800 of which have received approvals and 1,700 are pending. The table shows the number of certificates of approval received by classes.

Previous reports of your committee referred to revision of A. R. A. specifications so as to harmonize with I. C. C. requirements. During the year, the director of the Bureau of Service transmitted to all concerned a proposed revision of I. C. C. regulations and specifications, stating that in the event changes or modifications are desired, the Bureau of Explosives should be conferred with, the latter to submit proposed changes to the director, who would call a hearing thereafter.

Certificates of Approval Received, by Classes

Class	Number	
103	2422	General service
103A	76	Acid cars
103B	18	Rubber lined
103C	4	Chrome-iron plates
104A	30	Insulated
105	44	Hammer welded, insulated
105A300	65	Hammer welded, insulated
105A400	3	Hammer welded, insulated
105A500	4	Hammer welded, insulated
108	1	
Total	2667	

A sub-committee was appointed to prepare recommended changes in the proposed I. C. C. specifications, consisting of: F. A. Isaacson, engr. car construction, A. T. & S. F.; W. C. Lindner, chief car inspr., Pennsylvania; W. E. Cooper, supr. tank car dept., Bureau of Explosives; T. H. Beaghen, Jr., Mexican Petroleum Company; G. E. Tiley, supvr. tank car equip., General Chemical company; J. J. Root, asst. to v. p., Union Tank Car Company; V. Willoughby, chief mech. eng., American Car & Foundry Company; P. G. Winter (chairman), special assistant to secy., A. R. A.

With a view to aiding the Bureau of Explosives in presenting to the Bureau of Service specifications which will be largely representative of all concerned, the sub-committee has cooperated directly and indirectly with the following organizations: Bureau of Service, Interstate Commerce Commission; Bureau of Explosives; American Petroleum Institute; Chlorine Institute; American Railway Car Institute; Manufacturing Chemists' Association of the United States; Compressed Gas Manufacturers' Association.

The proposed I. C. C. specifications are to be minimum as to requirements and general in character. When these specifications are finally approved by the commission, the A. R. A. specifications will be revised. It is proposed to print the I. C. C. in the A. R. A. specifications in italics and then prescribe the A. R. A. details, to be consistent with the general requirements. This work has also been assigned to this sub-committee. Where the I. C. C. specifications refer to designs requiring approval, such approvals shall come from the A. R. A. Committee on Tank Cars. The statement of the director of the Bureau of Service in this report is that "The carriers, through the Tank Car Committee, shall be the judge as to whether or not the tank car and its appurtenances comply with the general specifications, which the Commission has laid down. If in doubt, the matter may be handled by the shippers through the court by mandamus, or the matter may be submitted to the commission. As to all devices which do not meet the general specifications laid down by the Commission but nevertheless seem to meet the necessary requirements from a safety standpoint, approval by the Commission for trial tests of such appliances should be requested."

After consideration of the recommended specifications the commission will call a hearing; and when and as orders are issued by the commission, the sub-committee will proceed with revision of the A. R. A. specifications. Date of hearing has not yet been set. The sub-committee has held five extended meetings, checking all calculations and material requirements.

The new container specifications will be the most comprehensive yet prepared, embodying the best thoughts of all interested parties. When issued, they will be given the effect of law by action of the Commission. The industrial development of new commodities to be transported in tank cars has been rapid, and will continue, and the work of this committee will embrace new designs and materials as they are needed. For that reason the classification of the tank cars will be sufficiently expansive.

The work of this sub-committee involves classification of containers and tank cars accordingly. In the past the A. R. A. classifications were designated by Roman numerals, such as I, II, III, IV, IVA, etc. The I. C. C. specifications provide for Arabic numerals, such as 103, 104, etc. The following shows the A. R. A. and I. C. C. classes of cars covered in the past and to be covered in the proposed specification revision.

Class of car	A.R.A. spec.	I.C.C. spec.	Effective date of present specifications
ARA-I	1926	none	Built prior to 1903
ARA-II	1926	none	Built between 1903 and 5-1-17
ARA-III	1926	Superseded by ICC-103, 7-1-27	Built between 5-1-17 and 7-1-27
ICC-103	none	ICC-103	Specification date 7-1-27
ICC-103A	none	ICC-103A	Specification date 7-1-27
ICC-103B	none	ICC-103B	Specification date 7-1-27
ICC-103C	none	ICC-103C	Specification date 8-15-28
ARA-IV	1926	Superseded by ICC-104, 7-1-27	Built between 5-1-17 and 7-1-27
ICC-104	none	ICC-104	Specification date 7-1-27
ARA-IV-A	1926	none	Built between 10-12-25 and 7-1-27
ICC-104A	none	ICC-104A	Specification date 11-1-27
ARA-V	1926	Superseded by ICC-105A500	Built between 1-1-18 and 7-1-27
ICC-105	none	ICC-105 (to be superseded)	Specification date 7-1-27
ICC-105A300	none	ICC-105A300	Specification date 8-15-28
ICC-105A400	none	ICC-105A400	Specification date 12-15-28
ICC-105A500	none	ICC-105A500	Specification date 12-15-28
ICC-105A600	none	ICC-105A600	Specification date 12-15-28
ARA-VI	1926	Superseded by Proposed ICC-107A3350	Specification date 1-1-25
ICC-106A500	none	ICC-106A500	Pending
ICC-106A800	none	ICC-106A800	Pending
ICC-107A3350	none	ICC-107A3350	Pending
ICC-108	none	ICC-108	Specification date 7-1-27
ICC-108A	none	ICC-108A	Specification date 7-1-27

The classifications are based on commodity characteristics as to whether they are (1) volatile inflammable with inflammable vapors given off at or below 20 deg. F., (2) volatile inflammable with inflammable vapors given off between 20 and 150 deg. F., (3) volatile non-inflammable with vapor pressures of 25 lb. or less per square inch at 100 deg. F., (4) non-volatile inflammable with non-inflammable characteristics below 150 deg. F., (5) dangerous and poisonous articles.

A list showing the specific products authorized for transportation in tank cars of each specification will be prepared upon approval of the I. C. C. specifications and incorporated in the A. R. A. tank car specifications. Classes I and II are no longer built their test pressure is 40 or 60 lb per. sq. in. Class III or 103 cars are for test pressures of 60 lb. per sq. in. and safety-valve setting at 25 lb. per sq. in. Classes IV and 104 are insulated cars for 75 lb. test pressure and a safety-valve setting of 25 lb. per sq. in.; Classes IV A and 104A are insulated cars for 100 lb. test pressure and 75 lb. safety-valve setting. The various classes of V or 105 cars have test pressures ranging from 300 to 600 lb. per sq. in respectively and safety valves set at 75 per cent of test pressure. Class 106 cars are for test pressure ranging from 500 to 800 lb. per sq. in. and safety-valves set at 75 per cent of test pressure. Class 107 cars are designed for a test pressure of 3,350 lb. per sq. in. and are equipped with special valves, or vents, having a setting of 100 per cent of test pressure. Class 108 cars are non-pressure vessels requiring a three-foot water-head test.

Heretofore the container specifications for multiple-unit cars were included in the I. C. C. regulations. The various types of multiple-unit containers are being reclassified and included in the specifications, including their mounting and anchorage. During the year the committee considered a multiple-unit car for

the U. S. Navy, consisting of 28 longitudinal seamless-tube tanks, each 35 ft. 7 5/16 in. long, 18½ in. outside diameter and 11/16 in. wall, for transporting helium gas at a pressure of 2,000 lb. per sq. in. The initial test pressure is 3,350 lb. per sq. in. hydrostatic. Ends are swedged and anchorage at swedged ends is by means of a bulkhead over each bolster. The car is standard height with running boards; one end is enclosed to protect valves. This car has a light weight of 207,000 lb. and loaded weight of 209,000 lb. It was passed on by the Committee on Car Construction and the Tank Car Committee.

All recommendations made in reports of the Tank Car Committee in the past few years, but which were not submitted to letter ballot, will be considered in the coming revision of the A. R. A. Specifications, so that no action is necessary at this time on hold-over matters.

Materials—Welding

Steel continues to be the universal material from which containers are manufactured and is suitable for most commodities. However, when subject to attack by lading, there has been considerable development in applying lining, such as glass, lead, tin, copper, rubber or composition metals. Aluminum is coming into use for tank shell, mostly for glacial acetic acid, considered as a non-dangerous commodity. One car was built during the year and is in experimental service. Chrome iron is also being used, four cars having been built. The Committee on Specifications and Tests for Materials has this material under consideration.

Numerous applications have been received for approval of welded instead of riveted tank seams. A sub-committee was appointed to inspect processes and workmanship. This sub-committee consists of: W. E. Cooper, supvr. tank car dept., Bureau of Explosives; T. H. Beaghen, Jr., Mexican Petroleum Corporation; E. Wanamaker, electrical engineer, C. R. I. & P. R.; J. J. Root, Jr., asst. to v. p., Union Tank Car Company; H. H. Service, welding supervisor, A. T. & S. F., and P. G. Winter (Chairman), special asst. to secy., A. R. A.

The Committee on Tank Cars will not consider any applications unless the sub-committee has had an opportunity to inspect the processes and make recommendation. Arrangements have been made with Purdue University to test welded specimens. The expense of testing welded specimens is to be borne by the applicant. No action will be taken by the Tank Car Committee until such tests have been made. The I. C. C. specifications do not at present permit autogenous welding of seams. During the year one car, PTX 2132, used in the transportation of non-dangerous articles, was approved by the committee for experimental service. A car with seams of the welded lock-bar type, as described in the 1926 report of your committee and approved for the transportation of non-dangerous articles, is still in service.

Tank Heads

A sub-committee was appointed to consider this matter, consisting of Messrs. F. A. Isaacson (chairman), W. C. Lindner, A. E. Smith and G. F. Tiley.

They recommended as follows for ARA Specifications:

The 10-ft. radius for tank heads on Class 103, 103-A, 103-B, 103-C, 104 and 104-A tanks should be continued except that this radius should be specified as a maximum.

It is recommended that the corner radius for the above classes of tanks shall be a minimum of 3¾ in.

It is recommended that on tank heads for Class 105, 105-A-300, 105-A-400, 105-A-500 and 105-A-600 Tanks the head shape will be of an ellipsoid of revolution in which the major axis will equal the diameter of the shell and the minor axis will be one-half of this.

Class 106-A-500 and 106-A-800, Class 107-A-3350 tanks are specially designed and some of them do not have standard outside form convex head. Each design of tank head is worked up specially for these tanks and details of construction should be submitted to the Tank Car Committee for approval.

Class 108, 108-A and 108-B tanks are non-pressure type tanks and it is not considered necessary to specify any definite tank head or corner radius.

The 1928 report contains the results of the work of a special joint committee of the American Petroleum Institute, American Railway Car Institute and American Railway Association. Meanwhile the commission published orders amending its regulations to the following effect:

> The safety valves now used on tank cars are reported to permit slow leakage of vapor and it appears that material changes in the design and construction of this valve are necessary to make it tight. The Commission has notified the American Railway Association, representing the carriers, and the American Petroleum Institute, representing the shippers, that the necessary changes must be made with the least possible delay. To accomplish this result new designs must be devised and tested experimentally, and in the meantime necessary shipments must be made in tank cars now available. Pending the accomplishment of these changes, tank cars whose safety valves permit only a slow leakage of vapor may be used.
>
> Until further order, a limited number of new or improved designs of safety valve, dome cover and bottom discharge-outlet equipment may be applied for service trials to tank cars used for the transportation of dangerous articles upon recommendation of the Tank Car Committee of the American Railway Association and approved by the Commission of the conditions under which the trials will be conducted.

Steps were taken to meet this order by a series of tests on safety valves, dome covers and bottom discharge outlets, conducted at the Union Tank Car Company's plant at Philadelphia, at which time certain designs were tested and from the results of the tests certain designs were recommended for service trial in the report of the joint committee, which was approved by the Tank Car Committee and included as an appendix to its report for 1928. These devices, as recommended, are still undergoing service trial. The Union Tank Car Company has kindly donated this testing apparatus to Purdue University where it is now being installed. The funds of the joint committee were also transferred by agreement to Purdue University to cover the cost of installation. All applicants having additional devices for tests will pay the expense thereof.

Tests at Purdue University

In addition to the joint committee referred to, there are two sub-committees of the Tank Car Committee working on these matters. The Sub-Committee on Dome Covers and Safety Valves consists of Messrs. Isaacson, McCormick, Smith and Lindner (chairman). The Sub-Committee on Bottom Outlets consists of Messrs. Isaacson, Beaghen, Smith, Meadows and Cooper (chairman). These sub-committees, together with the joint committee, will work with Purdue University on tests and results thereof. Details of this test were published as an appendix to B. W. Dunn's Annual Report of the Bureau of Explosives for the year 1928.

As to the continued performance of bottom outlet valves which have been approved by the sub-committee, they report as follows:

> Of the many different designs of valves previously considered by the sub-committee since its appointment, only one is at present undergoing service trial, namely, a cork-seated valve held on its seat by a threaded stem and cage. Of the others, only six have reached commercial production; four of these are of the metal-to-metal, beveled-seated type securely held in position by means of threaded stems and cages, one is of the piston type, and the other of the plug type. These valves have been authorized for use on approximately 14,000 tank cars to date, the initials and number of each car so equipped being furnished to the chairman of the sub-committee for checking against the Bureau of Explosives' record of accidents involving the bottom discharge outlets of tank cars.
>
> A study of the Bureau of Explosives' records indicates that valves of the types mentioned above have prevented loss of contents of the tank in cases where the bottom outlet casting has been broken off in an accident or in cases where the outlet chamber cap has been broken off by the freezing of water in the outlet chamber. Leakages of a minor nature have been reported against 59 of the 14,000 valves so far installed.

The Bureau of Explosives arranged with the Phillips Petroleum Company, at Burbank, Oklahoma, in November, 1928, for a test of a safety valve to determine the relief dimensions required on containers charged with liquefied gas when the exterior surface was subject to a temperature of 1,200 deg. F. The purpose was to determine amount of opening necessary to prevent building up of excess pressure. The safety valve was designed to release at 375 lb. per sq. in. The relief area of the valve was .278 sq. in. The results verified the formulæ developed for area of opening and when tank was subjected to fire the recording charts showed a pressure which ranged between 340 and 400 lb. until contents were exhausted. This work is of great importance in developing safety valves to meet the Commission's order. Details of this test were published as an appendix to B. W. Dunn's Annual Report of the Bureau of Explosives for the year 1928.

Anchorage

Some of the older cars still have head-block anchorage, and the limiting date of interchange had been set at January 1, 1930. Applications were received during the year for extension of

time limit to January 1, 1933. The matter of limiting dates was considered by the Arbitration Committee and the date extended to January 1, 1931.

At the January meeting the question of relative bearing and shearing values of connections to tank and underframe was referred to a sub-committee consisting of Messrs. Willoughby, Thompson and Stevenson. They made a report, the principles of which will be used in approvals, as the proposed I. C. C. specifications will provide that the design of anchorage shall be approved.

These specifications provide:

(1) In making computations to determine shearing and bearing areas the reamed hole shall be used, and the reamed hole must not exceed nominal size of rivet before driven by more than $\frac{1}{16}$ in.

(2) A single-piece anchor is defined as one having one longitudinal piece on each side of the underframe. A two-piece anchor is one in which there are two separate longitudinal pieces on each side of the underframe.

(3) For tank cars with single piece anchor and which do not exceed a weight of 169,000 lb. on the rail, that is, capacity of 50-ton trucks, the area of the rivets connecting tank to anchor should not be less than 30 sq. in. in shearing and 24 sq. in. in bearing area. For the connection between anchor and underframe there must be not less than 15 sq. in. in shearing and 12 sq. in. in bearing area. Taking the shearing and bearing areas of anchor connection between tank and anchor as 100 per cent, the shearing and bearing areas of the anchor connecting the underframe must not exceed 70 per cent of the above.

(4) For cars having two-piece anchorage as defined above, 20 per cent in excess of the above amounts is required.

(5) For cars requiring 70 ton trucks, or having a total load on rail in excess of 169,000 lb., the above requirements for single or two-piece anchorage must be increased 20 per cent.

Class 105 cars require plates inside of tank to cover rivets. This requires special test plugs, etc. A new design was received during the year which provides for forge-welding a T-shaped section into the bottom of the tank to form a keel for application of center anchor plates, eliminating rivets and test plugs through shell of tank and inside rivet cover plates. This design has been approved for experimental service for specific cars.

Heater Pipes

The method of application and character of material is subject to approval of the committee. A sub-committee consisting of Messrs. Isaacson, McCormick, Worman and Smith (chairman) considers new applications. Designs of heater-pipe installations for 435 Class 103 cars were checked and recommended for committee approval during the year.

Repairing and Patching Tanks

Interchange Rule 16 provides that repairs to cars shall conform to original construction. The I. C. C. Regulations also provide that:

damaged tank must be repaired in compliance with the specifications under which it was constructed. . . . A tank that bears evidence of damage to the metal by fire must be withdrawn from transportation service; provided, however, that where the damage to the tank is local only, or confined to a section not exceeding 25 per cent of the tank surface, the damaged material may be replaced.

Interpretation under A. R. A. Interchange Rule 16 states that patching may be done, provided the work conforms to the tank car specifications. These specifications do not at present cover. In 1926 a report and tentative recommendation was made by the Committee on Tank Cars and later approved by letter ballot. The sub-committee has been instructed to make a further study of the methods at present used in patching of tank cars and present recommendations as to how this matter may be covered in the specifications to be prepared. These recommendations are to be in conformity with the I. C. C. regulations as actually applied on existing tanks.

Car Structure

The A. R. A. specifications refer to such items as underframes, center sills, draft attachments, body bolsters, draft gears, couplers, brakes, trucks, etc. In tank-car construction, these parts must comply with requirements.

The report is signed by G. S. Goodwin (chairman) assistant to general superintendent motive power, Chicago, Rock Island & Pacific; A. G. Trumbull, chief mechanical engineer, Erie; George McCormick, general superintendent motive power, Southern Pacific; F. A. Isaacson, engineer car construction, Atchison, Topeka & Santa Fe; W. C. Lindner, chief car inspector, Pennsylvania; G. A. Young, head, school of mechanical engineering, Purdue University; W. E. Cooper, supervisor tank car department, Bureau of Explosives; A. E. Smith, vice-president, Union Tank Car; T. H. Beaghen, Jr., Mexican Petroleum Corporation; H. L. Worman, superintendent motive power, St. Louis-San Francisco; G. E. Tiley, supervisor tank car equipment, General Chemical Company, and C. C. Meadows, Tidal Refining Company.

Discussion

Chairman Smart: If there is no objection, I would like to extend the privilege of the floor to the tank-car builders and private tank-car lines.

Mr. Goodwin: At the last meeting of the Tank Car Committee, the following resolution was adopted:

It is unanimously decided that the chairman of the Tank Car Committee submit to the Bureau of Explosives, as soon as possible, final copies of all proposed Interstate Commerce Commission tank car specifications as modified to date, with the request that the Interstate Commerce Commission consider the issuance of further order and that the specifications be made effective within 90 days or less from date of private examination, with the understanding that should any exceptions be taken on the part of any interested parties, said exceptions to be heard and acted on for a hearing before the commission in connection with proposed general revision of the Interstate Commerce Commission rules for the transportation of explosives and other dangerous articles.

As indicating that the sub-committee has been successful in pleasing everyone, I will read a copy of a part of a resolution by the General Committee on Railroad Transportation of the American Petroleum Institute:

The Sub-Committee carefully considered every suggestion offered by the Petroleum Industry with the result that no objection has been raised as to the wording of the specifications or to the immediate submission to the Interstate Commerce Commission for immediate adoption without further hearing. The General Committee on Railroad Transportation desires to compliment the Committee on Tank Cars upon the admirable manner in which this difficult subject has been handled and to express its approval of the specifications and that they shall be submitted to the Interstate Commerce Commission for immediate adoption.

Mr. Trumbull: In adopting the report of the Arbitration Committee, the association has taken a step forward in eliminating the use of arch bar trucks from cars of new construction. Many tank cars are owned by private line companies that are not subscribers to the interchange rules, and the construction of these tank cars, therefore, would not be affected by the action of the Arbitration Committee, as approved by the association. It seems to me that that is a matter which should be recommended for special action of the association. I therefore move that the Tank Car Committee be instructed by the association that on and after January 1st, 1930, which is the date on which the rule respecting tank car trucks becomes effective, the Tank Car Committee shall not approve any tank car construction in which a new tank is applied to an old underframe, unless such underframe shall be carried on trucks having cast steel side frames; and provided that cast steel side frames on said second-hand trucks, if there are such, comply with the current A. R. A. specifications. The existing cast steel side frames of other designs and specifications may be used, but any such frames shall comply with the current A. R. A. specifications.

That will bring these trucks into conformity with the proposed standard of the Association respecting cast steel side frames on new tank car construction in so far as such construction is required to be approved by the Tank Car Committee.

Mr. Demarest: I will second the motion.

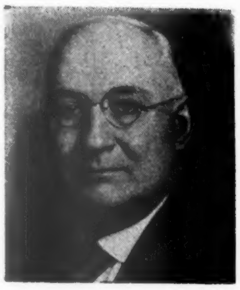
The motion was duly seconded and carried.

Chairman Smart: A motion would be in order, if there is no further discussion, to approve of this report and submit it to letter ballot.

Mr. Chambers: I so move.

The motion was duly seconded and carried.

Report of Committee on Loading Rules



S. Lynn
Chairman

During the past year your committee, as well as sub-committees, has held meetings with the shippers concerning recommendations for changes and additions to the loading rules.

Trial shipments embodying the recommended changes, as well as the new methods of loading, were sent out and carefully followed to destination to determine the safety and practicability of such loading.

As a result of the investigations, the following recommendations for changes and additions in the rules and cuts are submitted for approval and submission to letter ballot for adoption by the Association.

General Rules for Loading Materials

Rule 15

Proposed Form: This rule has been modified to eliminate one tie board per pair of stakes on loads not over (12) in. above sides of car because it is felt that loads of this height will be as safe with one tie board as loads three (3) ft., or over will be with two (2) tie boards. Also, to eliminate stakes on loads as described by the second paragraph, because a load of this character can not fall over the sides of the car and are just as safe without the stakes as they would be with them.

Fig 3, Page 14

It has been recommended to increase the length of the metal spacing blocks for twin and triple loads to 16 in. Also, to increase the length of the thread on the U-bolt used with 5-in. by 5-in., 5-in. by 7-in., or 6-in. by 8-in. shank couplers.

The length of these metal spacing blocks has been increased to insure better support for the striking castings and prevent crushing of them. The length of the thread on the U-bolt has been increased to 3 in. to eliminate the use of nuts, washers, etc., to take up all slack.

Group I—Rules Governing the Loading of Lumber, Logs, Ties, Fence Posts, Etc.

Rule 152

Proposed Form: The last phrase reading "or fastened to outside edge of first tie projecting above car side" has been omitted because of this method of securement causing a derailment account of wires being fastened to ties which extended only about one-fourth their thickness below the top of car sides. These ties, to which the wires were fastened, worked up above the sides of the car, allowing the ties to fall off the car to the track.

Group II—Rules Governing the Loading of Structural Material, Plates, Etc.

Rule 202

Proposed Form: Paragraphs 2, 3 and 4 of Rule 202 have been modified to permit diagonal loading of plates in gondola cars without the application of the anti-creeping features. Experimental shipments of over two hundred cars have proved this method of loading safe and satisfactory.

Rules 212, 215, 227-C and 231

Proposed Form: These rules have been modified at the request of a large shipper to permit the omission of braces as

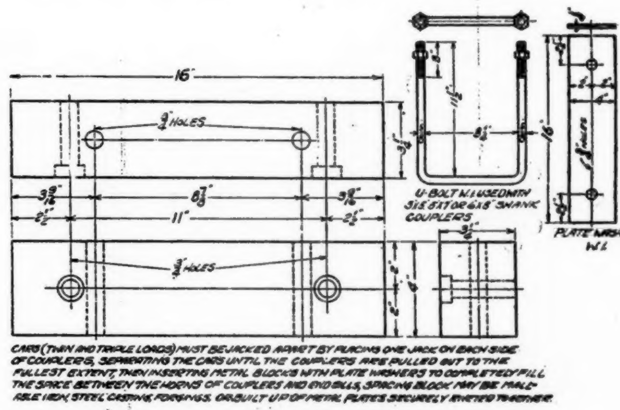


Fig 3—Metal spacing blocks for twin or triple leads

shown in Fig. 53, Page 103, for loads of structural shapes and plates, when individual piles in load exceed 24 in. in width, and the height does not exceed the width of the pile. Also, that the size of the side braces may be reduced from 6 in. by 8 in. to 4 in. by 6 in. for loads, as above described, up to 6 ft. in height. Experimental shipments have proved this method safe and satisfactory.

Rule 250-A

This rule has not been modified. Words were added to clarify the meaning to the reader without the necessity of referring to the marginal reference. The figure reference was

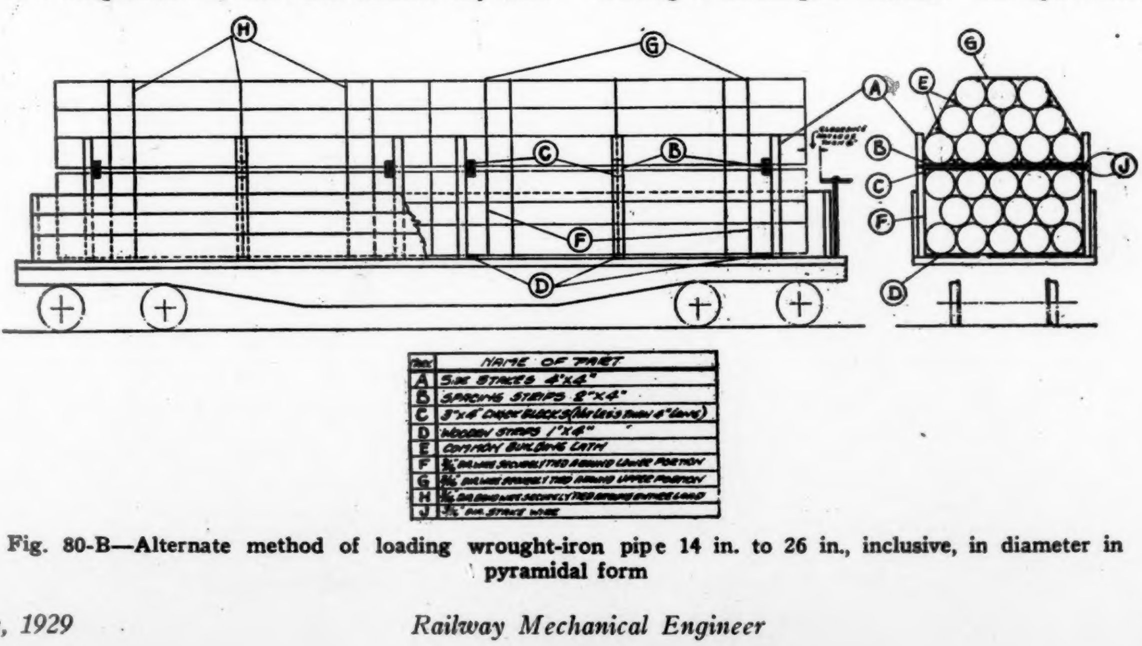


Fig. 80-B—Alternate method of loading wrought-iron pipe 14 in. to 26 in., inclusive, in diameter in pyramidal form

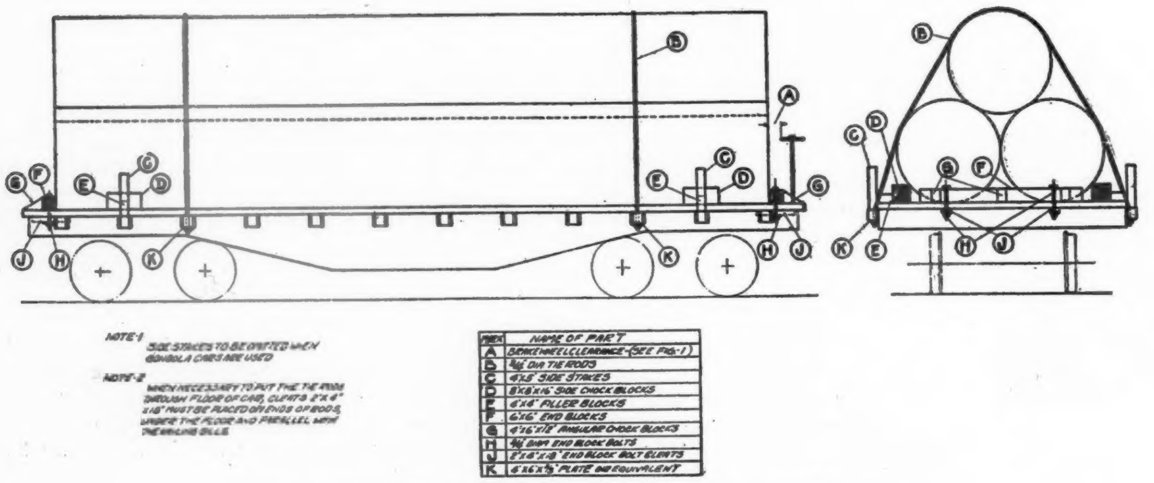


Fig. 81-G—Loading wrought-iron pipe on flat or gondola cars

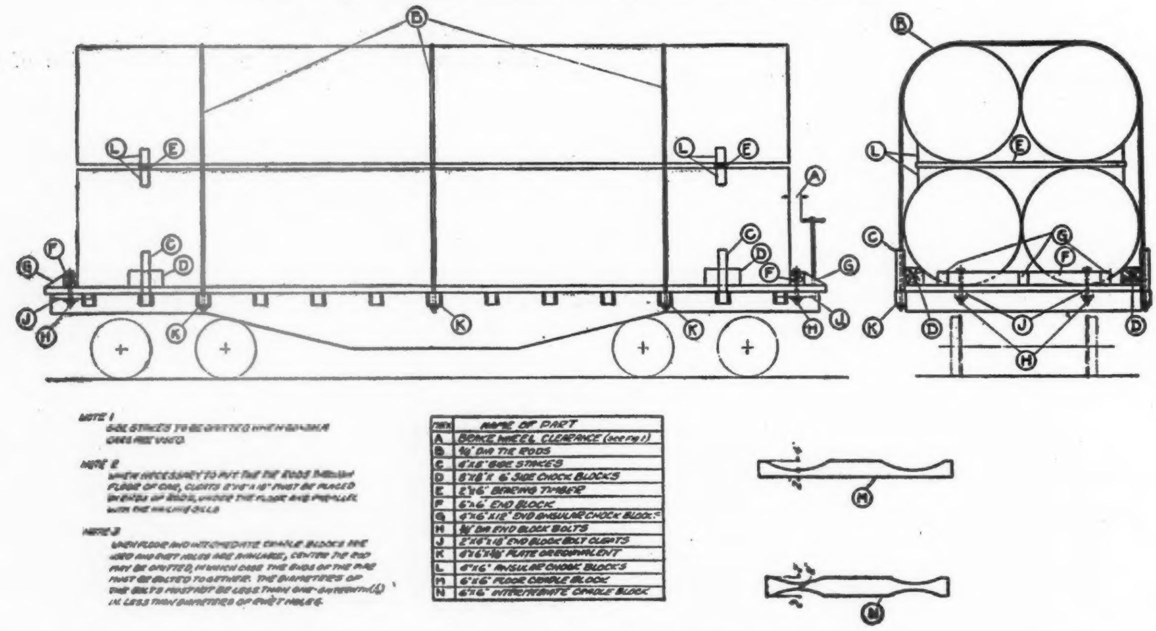


Fig. 81-H—Loading wrought-iron pipe on flat or gondola cars

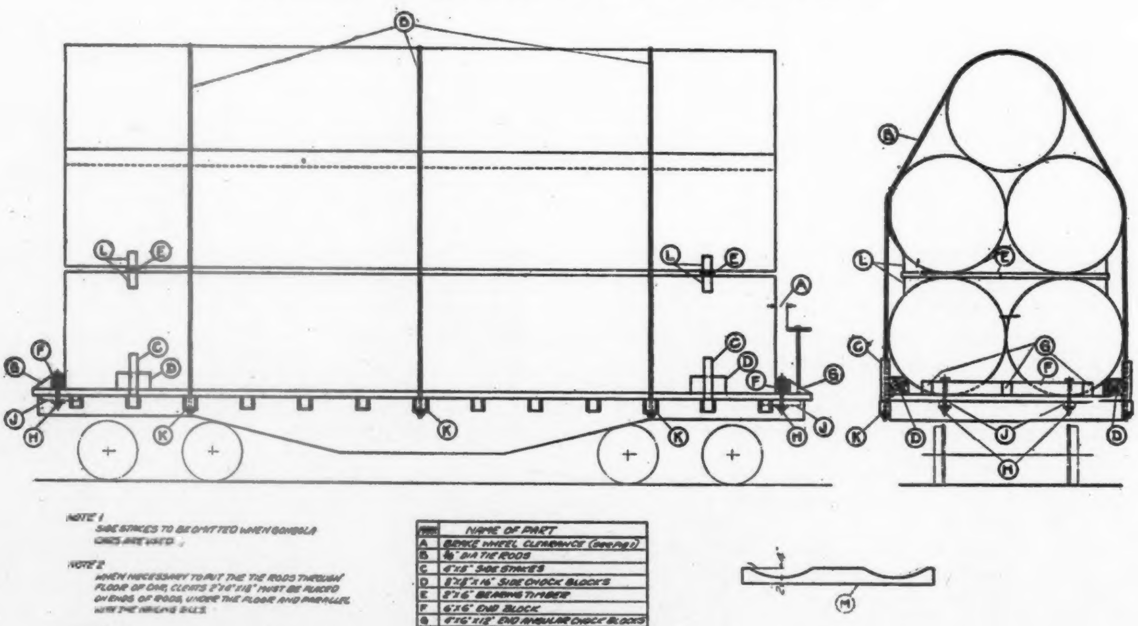


Fig. 81-I—Loading wrought-iron pipe on flat or gondola cars

changed to keep the cuts representing similar diameters of pipe together.

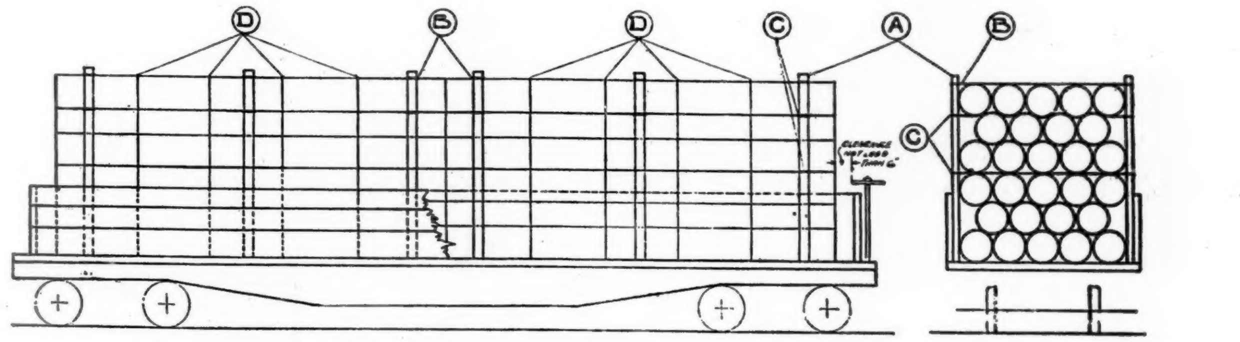
Rules 250-B, 251-A, 252, 253 and 254

These rules cover an alternate method of loading wrought-iron pipe 14 in. to 26 in., inclusive, in diameter, in pyramidal form.

Rule 250-B.—It was suggested to change the words "see Fig. 81-I" at the end of this rule to read "see Fig. 80-B." This was recommended because the majority of the pipe loaded in accordance with this rule will be 24 in. or less in diameter, and to keep the figures representing pipe of similar diameters together.

Rule 251-A. Proposed Form:—It was suggested to replace present Fig. 81-G with a new 81-G to show a more substantial method of bracing because of the method of bracing being inconsistent with the bracing of other similar commodities of lighter construction. This rule has been modified at the request of one of the large pipe and stack manufacturers to include new Figs. 81-G, 81-H and 81-I as alternates to the present methods shown in the book. A number of shipments braced according to these figures were run to destination safely and satisfactorily.

Rule 253 has been deleted and Rules 252 and 254 modified to overcome the objection of loading pipe above the top of car sides without some method of securement being employed; also, to prevent serious accidents which may result from this practice.



[illegible]	NAME OF PART
A	SIDE STAKES 4"X4"
B	3/16" DIA. STAKE WIRE OR BAND OF EQUIVALENT STRENGTH
C	3/16" DIA INTERMEDIATE STAKE WIRE OR BAND OF EQUIV. STRENGTH
D	3/16" DIA WIRE OR BAND OF EQUIVALENT STRENGTH

Fig. 80-A—Alternate method proposed by Committee on Loading Rules of loading wrought iron pipe less than 24-in. in diameter in gondola cars

Alternate Method of Loading Oiled or Highly Finished Sheets Lengthwise in Box Cars

Rule 274-A

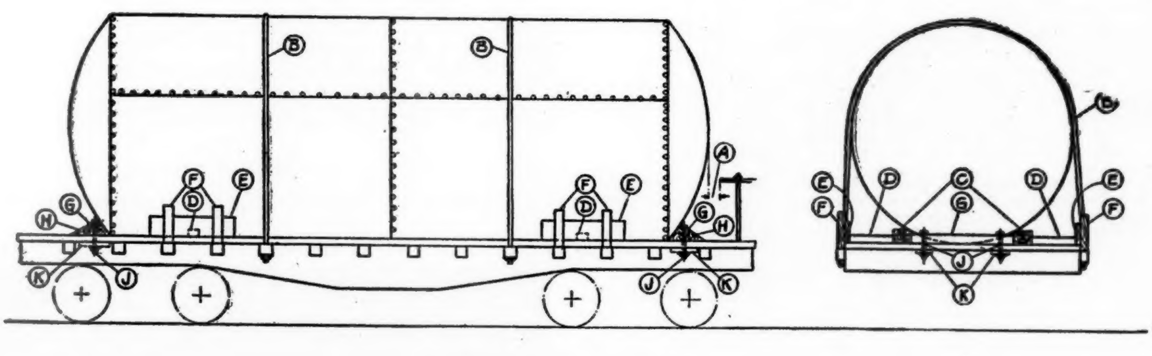
Loose sheets, loaded in accordance with the metal-band or wire-tying method, should be of uniform size. If the sheets vary in width or length wood fillers must be applied in such a manner that they cannot become displaced and will make the pile uniform size at the location where the ties are applied.

To prevent damage to sheets by bands or wires, corner angles of not less than 20-gage steel at least 4 in. wide and long enough to lap top, bottom, sides and ends of piles at least 3 in. must be placed under each band or wire and be so bent or crimped as to prevent displacement of the load.

Sheets must rest upon not less than two wood skids, free of knots, 1 in. by 3 in. in cross-section, or larger. Skids may be secured in position by tension of lengthwise bands or wires, and when so secured should not be more than 2 in. shorter than the pile and have both ends beveled. When skids are not secured to pile they must not be less than 12 in. longer than the pile except under pile nearest to the doorway, in which case skids should extend not less than 3 ft. beyond end of the pile toward the doorway.

Sheets must be loaded not less than 12 in. from the ends of car and ends of pile. To prevent the pile from creeping sideways a cleat, or cleats, at least 2 in. wide extending not less than 1 in. above bottom of pile must be placed parallel with and against the side towards center of car and securely nailed to floor with cement coated nails.

Sheets must be tied with bands or wires at least two locations lengthwise and at two locations crosswise, except where the bands are 4 in. or



[illegible]	No. Pcs	NAME OF PART
A		BRAKE WHEEL CLEARANCE NOT LESS THAN 6" FULL WIDTH OF CAR
B	2	TIE BANDS 3/4" DIA W.I. OR FLAT BANDS OF EQUAL SECTION
C	4	SIDE CHOCK BLOCKS 8"X10" NOT LESS THAN 16" LONG
D	4	WEDGE BLOCKS 4"X4"
E	4	BACKING UP BLOCK 2"X8" OR 4"X4"
F	8	SIDE STAKES 4"X5"
G	2	END BLOCKS 6"X6"
H	4	END ANGULAR CHOCK BLOCK 4"X5"
J	4	END BLOCK BOLTS 3/4" DIA
K	4	END BLOCK BOLT CLEATS 2"X4"X18"

Fig. 100—Boiler shells and tanks over 8 ft. in diameter

more in width, in which case one band lengthwise and two bands crosswise will be required.

Sheets, oiled or highly finished, must not weigh more than 20,000 lb. per pile or exceed 24 in. in height, exclusive of skids.

Tensile Strength of Bands or Wires Required on Oiled or Highly Finished Sheets

Weight per pile	Height of pile	Crosswise bands or wires, total tensile strength	Lengthwise bands or wires, total tensile strength
10,000 lb. or less...	24 in. or less	6,000 lb.	4,000 lb.
Over 10,000 lb. to 20,000 lb.........	15 in. or less	8,000 lb.	6,000 lb.
Over 10,000 lb. to 20,000 lb.........	Over 15 in. to 24 in.	12,000 lb.	6,000 lb.

All bands or wires must be equally tensioned to at least 60 per cent of the breaking point of the band or wire, while the weld, seal or twist-tie is being made. The weld, seal or twist-tie must be equivalent in strength to at least 85 per cent of the band or wire.

Loading Sheets Other Than Oiled or Highly Finished in Box Cars

274-B. Loose sheets, loaded in accordance with the metal band or wire-tying method, should be of uniform size. If the sheets vary in width or length, wood fillers must be applied in such a manner that they cannot become displaced and will make the pile a uniform size.

by six (6) in. lumber, bracing to consist of an upright, two (2) by six (6) in. near each end and extending four (4) in.

This rule covers the method of loading sheets crosswise of the car. It has been modified by adding the following sentence:

Where the space between the sides of the car and the ends of piles of sheets exceeds nine (9) in. bracing must be applied in accordance with Fig. 92-B, or any other method equally efficient.

It has been modified because of reports received of a number of cars having been derailed account of no bracing between the ends of the piles of sheets and sides of car. Due to the oscillating movement of the sheets in transit they move over against one side of the car, causing the side bearings to lock.

Group III—Loading Mining Cars, Engines, Machinery, Derricks and Similar Commodities

Rule 302

The second paragraph of Rule 302 has been modified to conform to present Fig. 100, which was modified and included in Supplement No. 2, effective January 1, 1928.

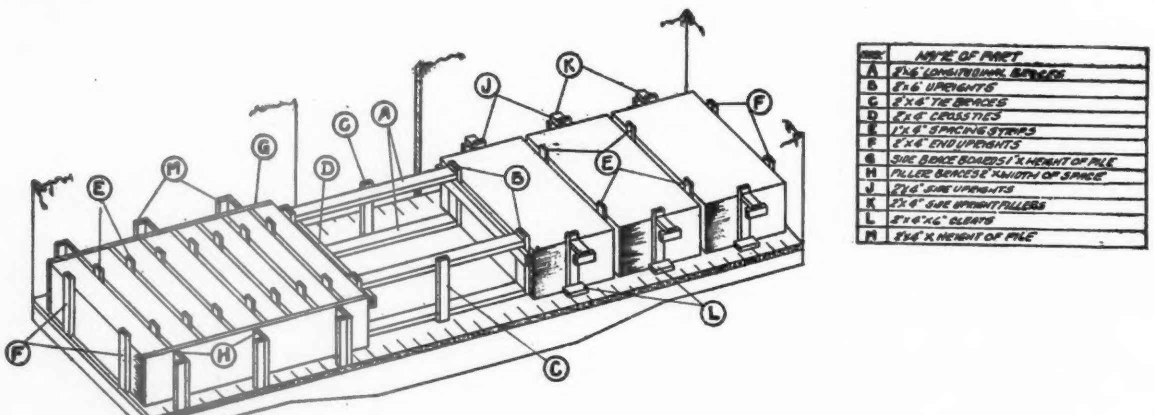


Fig. 92-B—Manner of loading sheets crosswise of car—Two methods of loading shown

To prevent damage to sheets by bands or wires, corner angles of not less than 20-gage steel at least 4 in. wide and long enough to lap top, bottom, sides and ends of piles at least 3 in. must be placed under each band or wire and so bent or crimped to prevent displacement.

Sheets must rest upon not less than two wood skids, free of knots, 1 in. by 3 in. in cross-section, or larger. Skids may be secured in position by tension of lengthwise bands or wires, and when so secured should not be more than 2 in. shorter than the pile, and have both ends beveled. When skids are not secured to pile they must not be less than 12 in. longer than the pile except under pile nearest to the doorway, in which case skids should extend not less than 3 ft. beyond end of pile toward doorway.

Sheets must be loaded not less than 12 in. from the ends of car and ends of pile. To prevent the pile from creeping sideways a cleat, or cleats, at least 2 in. wide extending not less than 1 in. above bottom of pile must be placed parallel with and against the side towards center of car and securely nailed to floor with cement coated nails.

Sheets must be tied with bands or wires at at least two locations lengthwise, and at two locations crosswise, with the two following exceptions: First, when the bands are 4 in. or more in width one band lengthwise and two bands crosswise will be required: Second, when no lengthwise bands are used no less than three crosswise bands or wires having a total tensile strength as specified in the following table will be required.

Tensile Strength of Bands or Wires Required on Sheets Other Than Oiled or Highly Finished

Weight per pile	Height of pile	Crosswise bands or wires, total tensile strength	Lengthwise bands or wires, total tensile strength	Crosswise bands or wires, when no lengthwise bands or wires are used, total tensile strength
3,000 lb. or less	Any	4,000 lb.	4,000 lb.	8,000 lb.
3,000 lb. to 15,000 lb. inc.	Any	6,000 lb.	4,000 lb.	10,000 lb.
Over 15,000 lb.	30 in. or less	6,000 lb.	4,000 lb.	12,000 lb.
Over 15,000 lb.	Over 30 in.	8,000 lb.	4,000 lb.	16,000 lb.

All bands or wires must be equally tensioned to at least 60 per cent of the breaking point of the band or wire, while the weld, seal or twist-tie is being made. The weld, seal or twist-tie must be equivalent in strength to at least 85 per cent of the band or wire.

Rule 275

Proposed Form: All sheets (plain or oiled) may be loaded crosswise of car, making piles of uniform height, extending the load to doorway and bracing across doorway with two (2)

It was suggested that dimensions "C," Fig. 100, be modified to read "side chock blocks 8 in. by 10 in. not less than 16 in. long." This modification was requested by one of the large tank shippers account of it being almost impossible for them to obtain 10-in. by 10-in. lumber at times. It is felt that 8-in. by 10-in. lumber will be satisfactory for these blocks.

Rule 306

This rule covers pivoted machines shipped on their own

Interior of the boiler shop of the Sir W. G. Armstrong Whitworth Company, Ltd., locomotive builders, Manchester, England

wheels. The following sentence has been added to the end of the note, page 230:

The light end of crane should trail. Where trucks are secured to body by keyed or nutted center pin, key or nut should be removed from pin on trailing end.

This note has been modified at the request of one of the large railroads on account of a derailment of a crane, caused by the lifting action on the light end of the crane, which was equipped with a center pin that was keyed at top and bottom.

Group IV—Rules Governing the Loading of Concrete Culvert Pipe, Brick, Stone, Etc.

RULE 405

Proposed Form: Paragraph 3—Three (3) in. slabs shipped in quantities loaded flat should have a slab not less than four (4) in. under each pile. There should be no more than eight (8) three (3) in. slabs in any one pile, either loaded on a four (4) in. slab, or on the floor of a car. Three (3) in. slabs longer than mine (9) ft. must be loaded on the edge or flat on a slab not less than four (4) in. in thickness or not more than two (2) on top of any shorter stack.

Paragraph 3 has been modified at the request of one of the large stone shippers, and corrects a former error in writing up the rule.

The report was signed by Samuel Lynn (chairman), superintendent rolling stock, Pittsburgh & Lake Erie; R. H. Dyer, general car inspector, Norfolk & Western; E. J. Robertson, superintendent car department, Minneapolis, St. Paul & Sault Ste. Marie; G. R. Lovejoy, master mechanic, Detroit Terminal; T. O. Sechrist, assistant superintendent machinery, Louisville & Nashville; C. J. Nelson, chief inspector, Chicago Car Interchange Bureau; R. B. Rasbridge, superintendent car department, Reading, and G. A. Marlow, chief car inspector, Pennsylvania.

The report was accepted and referred to letter ballot, a rising vote of thanks being extended to the committee.

Report on the Power-Brake Investigation

By H. A. Johnson

Director of Research

H. A. Johnson

The investigation of power brakes and appliances for operating power brake systems, being conducted by the American Railway Association at Purdue University test laboratory under order No. 13528 of the Interstate Commerce Commission has been continued during the past year.

At the request of the Automatic Retaining Valve Company for permission to submit the James triple valve for consideration, the American Railway Association placed an order for 25 of these triple valves and they were delivered at Purdue University on February 11, 1929. Up to the time of the preparation of this report Mr. James was engaged in making changes on these 25 triple valves and had not yet submitted them for the official tests.

The preliminary preparations for road tests have gone forward during the past year. A schedule of road tests was prepared and copies forwarded to the Bureau of Safety, Interstate Commerce Commission, the air-brake manufacturers, and members of the Committee on Safety Appliances and of the Committee on Brakes and Brake Equipment. Special instruments for graphically recording slack action and degree of shock in a moving train have been designed and built. Other appliances and equipment required for properly recording the data to be taken during the conduct of the road tests have been purchased and manufactured. A canvass of the railroads of the United States was made to determine those roads which had the desired grade and track conditions for the road tests. This canvass showed that the Southern Pacific, on its line between San Francisco, California, and Portland, Oregon, had conditions of heavy mountain grade operation, long moderate grade operation and level road operation, which met the desired conditions better than any other railroad. The Southern Pacific has agreed to cooperate with the American Railway Association in the conduct of these road tests and a contract between these two parties is now being prepared. The heavy-grade tests will be made between Hornbrook, California, and Ashland, Oregon. The moderate-grade tests will be made between Ashland, Oregon, and Grants Pass, Oregon. The level road tests will be made in the vicinity of Walker, Oregon.

The director of research submitted a report entitled "Preliminary Report of the Tests Made on the American Railway Association's Test Rack at Purdue University in Connection with the Investigation of Power Brakes and Appliances for

Table I—Summary of the Features Claimed for the Various Equipments Tested

STANDARD K	A. S. A.	WESTINGHOUSE FC-5	WESTINGHOUSE FC-3
	1—Elimination of undesired quick action.	1—Elimination of undesired quick action.	1—Elimination of undesired quick action.
2—Quick action.	2—Emergency quick action available at all times.	2—Emergency quick action available at all times.	2—Emergency quick action available at all times.
3—High pressure in emergency.	3—High pressure in emergency.	3—High pressure in emergency.	3—High pressure in emergency.
	4—Graduated release.	4—Graduated release.	
5—Direct release operation.	5—Direct release operation.	5—Direct release operation.	5—Direct release operation.
6—Cycling operation.	6—Cycling (retention) operation.	6—Cycling operation.	6—Cycling operation.
7—Uniform release.	7—Uniform release.	7—Uniform release.	7—Uniform release.
8—Uniform recharge.	8—Non-overcharge feature.	8—Uniform recharge.	8—Uniform recharge.
	9—Quick release (in direct release only).	9—Quick release and quick recharge.	9—Quick release and quick recharge.
	10—2½ to 1 ratio of brake cylinder pressure development to brake pipe reduction.	10—2½ to 1 ratio of brake cylinder pressure development to brake pipe reduction.	
	11—Harmonious operation in trains of mixed equipment with A.S.A. in retention position.	11—Harmonious operation in trains of mixed equipment except in graduated release and development of brake cylinder pressure.	11—Harmonious operation in trains of mixed equipment.
	12—Maintenance of brake cylinder pressures against leakage.	12—Maintenance of brake cylinder pressures against leakage.	
	13—Compensations for variations in piston travel.	13—Compensations for variations in piston travel, 6" to 12".	
14—Quick service.		14—Positive quick service.	14—Positive quick service.
	15—Closed angle cock feature.	15—Closed angle cock feature.	15—Closed angle cock feature.
	16—Continuous train control.		
	17—Prevention of excessive braking power on head end of trains in grade braking.		
	18—Maintenance of braking power on rear end of long trains.		

Operating Power-Brake Systems" to the General Committee of the Mechanical Division at its meeting in Chicago, March 20, 1929. This report was accepted by the General Committee and forwarded to R. H. Aishton, president of the American Railway Association, with a statement that the recommendations made by the director of research were concurred in by the Committee on Safety Appliances and the General Committee. Mr. Aishton forwarded copies of this preliminary report to the Interstate Commerce Commission. This report, copy of which is included as an appendix, contained the following recommendations:

Recommendations

1—That the Automatic Straight Air Brake Company's graduated release equipment has failed to show sufficient merit in the rack tests to warrant the conduct of road tests with this equipment.

2—That road tests under actual service conditions shall be made with the following brake equipments:

(a) The standard type K equipment in order to obtain a basis of comparison with the new equipments to be tested.

(b) The Westinghouse type FC-5 equipment, since, of the two equipments designed to meet the tentative specifications and requirements of the Interstate Commerce Commission, the FC-5 equipment more nearly met these specifications and requirements than the A. S. A. equipment. The FC-5 equipment has also other features, not covered in this specification, which make it desirable to submit this equipment to road tests.

(c) The Westinghouse type FC-3 equipment, as the rack tests developed many features which appear to make this equipment desirable for modern freight-train operation. This equipment also met a part of the tentative specifications and requirements of the commission.

The complete report of the rack tests has been in the course of preparation for several months. It will not be completed in time for presentation at the annual meeting of the Mechanical division but it will be included as a part of the printed proceedings of this meeting.

Appendix I—Preliminary Report on Purdue Brake Tests

The features claimed for the Automatic Straight Air Brake Company's brake equipment and for the Westinghouse standard K, FC-5 and FC-3 equipments are summarized in Table I. Table II shows the number of rack tests made on each brake equipment since the start of this investigation with the dates of starting and completion of each series of tests.

While the detailed data and results of the great number of rack tests are not ready for presentation in tabular and graphic form at this time, a thorough analysis of the results of these rack tests shows the characteristics of the several air brake equipments pointed out in the following paragraphs.

Rack Tests Develop Undesirable A. S. A. Features

The rack tests on the Automatic Straight Air Brake Company's equipment developed the following undesirable features;

1—Undesired emergency application of the brakes was obtained in some cases when a service reduction of brake pipe pressure was made at the brake valve.

2—It was practically impossible to make service reductions of brake-pipe pressure of less than 9 lb. This condition was aggravated by brake-cylinder leakage and piston travel of more than 8-in.

3—Undesired release of the brakes on part of the train and in some cases on the entire train was obtained under certain conditions. This undesired release existed when the valves were set in direct release position and did not occur when the valves were set in graduated release position or in cycling (retention) position. The probability of obtaining undesired release was increased with the use of the A. S. A. locomotive compensating valve and was also more prevalent after light service reductions of brake pipe pressure with low brake pipe leakage. These releases were caused by surges of the brake pipe pressure which were started by one or more brake cylinders drawing too much air from the brake pipe to compensate for leakage or long piston travel, followed by a part of the air being returned into the brake pipe. This local rise in brake pipe pressure caused a few of the triple valves to go to release position, thereby bringing about the release of air into the brake pipe from the emergency reservoirs on these cars and resulting in heavier surges of brake-pipe pressure. This, in turn, caused more valves to move to release position until in some cases the brakes on the entire train released. This condition was aggravated as brake-cylinder leakage increased. Undesired releases of the brakes were also obtained with six-inch piston travel on the front half of the train and with ten-inch piston travel on the rear half of the train.

4—Lack of control of graduated release on the rear portion of a 100-car train under certain conditions. With the equipments on the 100-car rack set in graduated release position, the brake-valve operator could graduate off the brake-cylinder pressures as long as the brake-pipe and brake-cylinder leakages were very low. As the leakages increased, however, the brake valve operator began to lose control of the release of brake-cylinder pressures until with A. R. A. maximum permissible leakage in brake pipe and brake cylinders the pressure in the brake cylinders could be graduated off on only the first third of the 100-car train. Whether this condition would be detrimental in actual service or would operate on the side of safety can only be determined by road tests.

5—The time required to release the brakes when set in graduated release position equals the time required to recharge the entire brake system and increases greatly with increased brake-pipe and brake-cylinder leakage as the air compressor must overcome both the brake-pipe and brake-cylinder leakage before the brake-pipe pressure can be raised. If the brake-cylinder pressure has equalized with the auxiliary-reservoir pressure and has leaked down below the equalization point, it is necessary to supply sufficient air from the locomotive to raise the pressure in the brake cylinder and auxiliary reservoir back to the equalization point before the brake-cylinder pressure starts to release to atmosphere.

6—*Slow emergency propagation*—The time required to get an emergency application through a 100-car train was approximately 50 per cent longer with the A. S. A. brakes than with the standard type K brakes.

Table II—Rack Tests Made on Each Brake Equipment

Equipment	No. of tests made	Tests started	Tests completed
100 Type K triple valves....	621	Nov. 30, 1925	June 30, 1926
100 A.S.A. triple valves......	602	Aug. 17, 1926	Apr. 6, 1927
Mixed equipment of 50 Type K and 50 A.S.A. brakes...	188	Apr. 25, 1927	July 20, 1927
100 Westinghouse FC-5 brakes	611	Sept. 27, 1927	Mar. 29, 1928
Mixed equipments of 50 Type K and 50 FC-5 brakes.....	168	Apr. 17, 1928	June 20, 1928
100 Westinghouse FC-3 brakes	393	Aug. 1, 1928	Nov. 14, 1928
Mixed equipments of 50 Type K and 50 FC-3 brakes.....	114	Dec. 11, 1928	Jan. 24, 1929

7—*Loss of brake-cylinder pressure when over-reduction is made*—When an over-reduction in brake-pipe pressure was made below the equalization point of the brake-cylinder and auxiliary-reservoir pressure, the brake-cylinder and auxiliary-reservoir pressures were reduced with the brake pipe pressure.

8—Emergency application including high emergency brake-cylinder pressure following a full service application was obtained in approximately half of the trials. In case quick action fails, not only was there a failure to obtain emergency brake-cylinder pressure but the brake-cylinder pressure obtained from the full service application was exhausted to atmosphere through the emergency port in the brake valve.

9—Leakage in emergency reservoir or failure of emergency reservoir to charge resulted in corresponding loss of braking power. During the tests there were a number of cases of emergency reservoirs on certain cars failing to recharge, resulting in the failure of the brakes on these cars to apply upon the following service reduction of brake pipe pressure. Leakage in the emergency reservoirs causing low emergency-reservoir pressures would have the same effect as the development of brake-cylinder pressure is in direct proportion to the difference in the pressures of the emergency reservoirs and the brake pipe.

10—An overcharge of the emergency reservoir with the A. S. A. equipment set in graduated release or retention position can be reduced only by making one or more emergency applications.

11—The time required to charge the A. S. A. equipment from zero to 65 lb. pressure and the time required to recharge the equipment to 65 lb. following an emergency application of the brakes was more than twice that required by the standard K equipment. In recharging tests following a full service application with low brake-pipe leakage, the A. S. A. equipment recharged to 65 lb. in approximately the same time as the standard K equipment. However, as the brake-pipe leakage was increased the time required to recharge to 65 lb. was greater for the A. S. A. equipment than the standard K equipment.

12—Brake-cylinder maintaining feature of A. S. A. valves caused undesired release of standard type K valves in mixed-train operation under certain conditions. These undesired releases existed when the valves were set in direct release position and did not occur when the triple valves were set in graduated release or in cycling (retention) position. These releases took place with light service reductions of brake-pipe pressure and with low brake-pipe leakage and when the compensating valve on the locomotive was cut in. These releases were caused by the surging of the brake-pipe pressure resulting from the A. S. A. equipments drawing upon the brake pipe to compensate for brake-cylinder leakage or for variation in piston travel. The rise in brake-pipe pressure during the surges was of such extent as to move the standard type K valves to release position and to release the brakes on these cars. As the surging continued to increase, the brakes on the cars equipped with A. S. A. valves also released. Under these conditions, if undesired releases did not occur, the type K brakes leaked off faster than they would in case the locomotive compensating valve was not maintaining the brake pipe pressure and they were permitted to go to equalization due to the brake-pipe leakage.

13—The A. S. A. equipment failed to develop equal braking power to that of the type K brake in cycling operation.

Advantageous Features of A. S. A. Compared with Westinghouse K Equipment

The following paragraphs describe the features in which the A. S. A. brake equipment operated more favorably than the standard K equipment:

1—The length of time required by the A. S. A. equipment to get a service application through a 100-car train was less than that required with the standard type K equipment, particularly when the brake-pipe leakage was very low.

2—Quick action and emergency brake-cylinder pressures were obtained with the A. S. A. equipment following service applications when such service applications resulted from a reduction in brake-pipe pressure not exceeding about 20 lb. In the case of the standard K equipment quick action, an emergency brake-cylinder pressure did not result when an emergency rate of reduction in brake-pipe pressure was made following a service application of the brakes when the service application was the result of a reduction in brake-pipe pressure in excess of about 8 lb.

3—Quick action was obtained with the A. S. A. equipment following release after full service applications resulting from service reductions of 25 lb. in brake-pipe pressure, while with the standard type K equipment quick action following release after full service applications was obtained in only a small percentage of the trials.

Undesirable Features of Westinghouse FC-5

The rack tests on the Westinghouse type FC-5 equipment, which was designed to meet the tentative specifications and requirements of the Interstate Commerce Commission, developed the following undesirable features:

1—Lack of control of graduated release on the rear portion of a 100-car train under certain conditions. With the FC-5 equipments on the 100-car rack set in graduated release position, the release of brake-cylinder pressures could be controlled as long as the brake-pipe and brake-cylinder leakages were very low. As the leakages increased, however, the brake-valve operator began to lose control of the brake cylinder pressures on the rear end of the train, until with the A. R. A. maximum permissible leakage in both brake pipe and brake cylinders, the pressure in the brake cylinders could be graduated off only on the first third of the 100-car train. Whether this condition would be detrimental in actual service or would operate on the side of safety con only be determined by road tests.

2—The time required to release the brakes when set in graduated-release position equals the time required to recharge the entire brake system and increases greatly with increased brake-pipe and brake-cylinder leakage, as the air compressor must overcome both the brake-pipe and brake-cylinder leakage before brake-pipe pressure can be raised. If the brake-cylinder pressure has equalized with the auxiliary- and maintaining-reservoir pressures and has leaked down below the equalization point, it is necessary to supply sufficient air from the locomotive to raise the pressure in the brake cylinder, auxiliary and maintaining reservoirs back to the equalization point before the brake-cylinder pressure starts to release to atmosphere.

3—The time required to charge the brake system from zero to 65 lb. pressure and the time to recharge to 65 lb. following an emergency application of the brakes was approximately two and one-half times that required by the standard K equipment. In recharging tests, however, following a full service application of the brakes and with low brake-pipe leakage, the FC-5 equipment recharged to 65 lb. in approximately the same time as the standard K equipment. As the brake-pipe leakage was increased the time required to recharge to 65 lb. pressure was greater for the FC-5 equipment than for the standard K equipment.

4—An over-charge of the emergency reservoir with the FC-5 equipment set in either graduated-release or cycling position can be reduced only by making one or more emergency applications.

5—In the test in which the brake-valve operator used the cycling method of control with brake-pipe leakage of 7 lb. per minute and brake-cylinder leakage on each of the 100 cars of 17 lb. per minute, the brake-valve operator was not able to control the brake-cylinder pressure on approximately the rear half of the train after the fifty cycle. These equipments, instead of releasing in each cycle with the brake-valve movement to release position and reapplying with the following service reduction in brake-pipe pressure, continued to build up the brake cylinder pressure until the equalization point of the pressures in the brake cylinder, auxiliary reservoir and maintaining reservoir was reached. This condition resulted in heavier brake-cylinder pressure than was desired on the rear half of the train. In general, either brake-pipe leakage alone or brake-cylinder leakage alone or both leakages combined resulted in higher average brake-cylinder pressures on the rear portion of the 100-car train than on the head portion of the train, and the heavier the leakage the more pronounced this difference of braking power. Whether these conditions would be detrimental in actual service or would operate on the side of safety can only be determined by road tests.

Favorable Features of FC-5 Equipments

The rack tests on the Westinghouse type FC-5 equipments brought out the following favorable features:

1—Undesired emergency applications were eliminated.

2—The positive quick service of the FC-5 equipment resulted in getting a service application through the 100-car train in less time than that taken by either the standard type K or A. S. A. equipments. In a train of mixed equipments of standard type K and FC-5 brakes, this feature would improve the brake operation of the standard type K equipments.

3—The FC-5 equipments made a more uniform release, when the 100 brakes were set in a direct-release position, than either the standard type K or A. S. A. equipments.

4—Emergency quick action and high emergency brake-cylinder pressures were available at all times.

5—In case it is ultimately decided that compensation for brake-cylinder leakage and for variation in piston travel is necessary or desirable, the method of accomplishing this feature used in the Westinghouse FC-5 equipment is less objectionable than the method used in the A. S. A. equipment.

Rack-Test Results With FC-3 Equipments

The rack tests on the Westinghouse type FC-3 equipments,

designed to meet part, but not all of the tentative specifications and requirements of the Interstate Commerce Commission, developed the following undesirable features:

1—The time required to charge the FC-3 brake equipment from zero to 65 lb. was more than two times that required by the standard K equipment. In recharging tests, however, following a full service application of brakes and with low brake-pipe leakage, the FC-3 equipment recharged to 65 lb. in approximately the same time as the standard K equipment. As the brake-pipe leakage was increased, the time required to recharge to 65 lb. pressure was greater for the FC-3 equipment than for the standard K equipment.

2—There was a greater variation in the closing value of the brake-cylinder pressure-retaining valves on the Westinghouse FC-3 equipments on the 100-car train than with the retaining valves used with the standard K equipments.

The rack tests on the Westinghouse FC-3 equipment developed the following favorable features:

1—Undesirable emergency applications were eliminated.

2—The positive quick service of the FC-3 equipment resulted in getting a service application through the 100-car train in less time than that taken by either the standard K or A. S. A. equipment and in about the same time as taken by the FC-5 equipment. In a train of mixed equipments of standard type K and FC-3 brakes, this feature would improve the brake operation of the standard type K equipments.

3—The FC-3 equipments made a more uniform release, when the 100 brakes were set in direct-release than either the standard type K, A.S.A. or FC-5 equipments.

4—Emergency quick action and high emergency brake-cylinder pressures were available at all times.

5—The controlled development of high brake-cylinder pressure in emergency consisted of building the brake-cylinder pressure from zero to about 15 lb. at a very rapid rate, similar to the rate of build-up in emergency of the standard type K. From about 15 lb. to 30 lb. the build-up of brake cylinder pressure is made at a slow service rate and from this point on the final build-up is made at a much faster rate. This method of build-up of pressure in emergency is designed to reduce the train shocks resulting from an emergency application of the brakes. Road tests will be necessary to determine the amount of reduction in train shock and the effect upon stopping distance.

While rack tests are the best means of making a detailed study of the functions of an air brake equipment, road tests are necessary to determine if an air-brake equipment meets road conditions safely in service. Any new air-brake equipment could not be considered for adoption before it had successfully passed both rack tests and road tests. On the other hand if an air-brake equipment does not successfully pass the rack tests, it would not operate safely and satisfactorily under actual service conditions.

Discussion

Mr. Johnson: The work up-to-date has only included the rack test at Purdue University, which is limited to 100 cars. There has been no particular trouble with the 100-car train. Just what we are going to get into with longer trains we are unable to say at this time, but on the road test, tests will be made with trains up to 150 cars in length, and that may bring out some information that we do not now have.

Mr. Demarest: I want to ask if, in the handling of tests on the rack whether they maintained a tight train line, or endeavored to duplicate an average road condition with an average train line leakage?

Mr. Johnson: The tests at Purdue were made to try to duplicate service conditions as nearly as possible, and also to set up a usual condition that is found in service. All the tests were repeated with a tight train line, and by tight we mean a train line where the leakage is less than one lb. per min. from 70 lb., which we were able to maintain on the test rack. Then we also developed train line leakage of 7 lb. per min., and repeated the test showing the effect of the brake pipe leakage.

The tests were then made with tight cylinders in which the brake cylinder leakage was under 2 lb. per min. from 50 lb. The same tests were repeated with a brake cylinder leakage of 5 lb. per min., 12 lb. per min. and 17 lb. per min., the condition of tight brake pipes with each of the various cylinder leakages being set up, and also the condition of 7 lb. brake pipe leakage with each of the cylinder leakage conditions being set up. There is a vast difference in operation, with the present equipment, dependent upon the amount of leakage, both in brake pipe and in brake cylinder leakage, and the report on the leak test will show it.

Within a few weeks we will set up all of these different conditions so that you can see in graphical form how the equipment acts under the different combinations of the different locomotives. That is one of the principal reasons why it has taken so long to complete these rack tests. When the schedule was originally submitted to the Committee on Brakes and Brake Equipment, it requested all of these various modifications.

The program, I think, has been well worth while, because, with some of these equipments, the operation was quite satisfactory with a tight brake pipe and tight cylinders, but when you get 7 lb. brake pipe cylinder leakage or 12 lb. brake cylinder leakage, which is permissible under the A. R. A. maintenance rules, you have quite a different situation.

A. H. Hoffman (S. P.): When these tests were being made with the K triple valves, what kind of graduating springs were used? Were you using the P C 1057 or the heavier spring?

Mr. Johnson: The standard triple valve graduating spring has been used in the basic test because that is the standard of the association. The brake committee requested us to develop the difference between the standard spring and the heavy spring. A series of over 100 tests was made on the heavy springs, duplicating the corresponding tests on the standard spring, to show the effect of the heavy spring on the operation, and that will all be available in this report. In short, the effect in this undesired quick action is very largely eliminated by the heavy spring, but you pay a price in the feature of trying to obtain emergency after a service reduction, and the ability to obtain an emergency after even a light service reduction is practically eliminated by the use of the heavy spring.

When you see this printed report, it will show in graphical form, and in figures, just the price that you would have to pay for using the heavy spring. Later on we may put in some of the heavy springs to see the effect on the road tests.

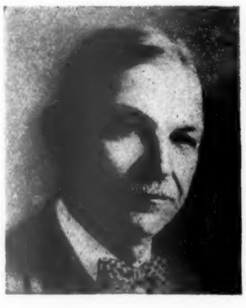
Mr. Hoffman: Were these tests with the K triple made under varying temperature conditions?

Mr. Johnson: The temperature conditions did not vary greatly inside of the test building, which is heated in the winter time, the temperature being nearly constant. I presume the minimum temperature was not below 60, and the maximum not over 100. I might add, however, that we did run into considerable trouble with moisture and oil in the brake pipe getting into the K valves. During the conduct of the K test, we had to stop several times and clean the valves so that we could go on. In the conduct of the A. S. A. test we also had to stop to clean valves and for adjustments. In the test on the Westinghouse F C-5 and F C-3 equipment, we did not have to stop for any purpose during the entire series of tests.

Mr. Demarest: I move we adopt the report, and it be spread in the record.

The motion was duly seconded and carried.

Report of Sub-Committee on Apprentices



F. W. Thomas
Chairman

The sub-committee met at Chicago, November 9, 1928, and prepared a questionnaire which was submitted to the member roads. Copy of this questionnaire and a summary of the replies received are included in Exhibits A and B.

A study of the replies to the questionnaire indicates a deep interest in the subject of training of apprentices. This interest is doubtless influenced by the need of extending the training to railroads which do not have an adequate plan of training young men to be mechanics in the service.

The object of an apprenticeship system is to develop carefully selected young men for the purpose of supplying leading workmen for future needs, with the expectation that those capable of advancement will reveal their ability and take places in the organization for which they are qualified. The number of apprentices should be governed by the need of the company for new men to replace those who have reached the age of retirement, to replace those leaving the service, and to take care of any enlargement of shop forces that may be necessary from time to time.

The success of the training system depends in large measure on the degree of care exercised in the selection of competent applicants for apprenticeship. As a rule boys leaving school in or below the eighth grade do so because of lack of ability, or lack of intelligence. Great care must, therefore, be exercised in the examination of applicants so that only those with the proper degree of intelligence are employed. The entrance test should be such as will reveal ability, rather than accumulated knowledge.

A careful review of the information submitted in replies to the questionnaire brings out points worthy of consideration in establishing a system of apprenticeship training.

The training of apprentices embodies two distinct phases; namely, shop training and school training. The shop training should follow a definite shop schedule, giving the tour of duty of the apprentice in the various departments, covering a variety of work which will give the apprentice an all-around knowledge of shop practice, as well as develop in him the necessary skill in operating the standard machines, and to become proficient in bench and erecting work. This work should be arranged in logical sequence according to the degree of its difficulty or performance. Certain machines ought to be set aside to be operated at all times by apprentices.

The schedules for apprenticeship shop training, shown in Exhibit C, are typical schedules and may be varied from in detail, depending upon facilities, conditions and length of apprenticeship.

It is suggested that where a sufficient number of apprentices are employed that apprentice shop instructors, carefully selected, should be appointed, as it is believed that the foreman has not sufficient time to give the boy the necessary shop training. Schools with compulsory attendance and progress should be maintained. School instruction should cover classroom work in related technical subjects and mechanical drawing. The classroom work should cover instructions as listed under Exhibit D.

The outlines contained in the above exhibit are typical and no doubt standard courses of instruction can be obtained from other sources, such as cooperation with state institutions, city institutions and correspondence schools.

Apprentices failing to make satisfactory progress in shop and in school work over a pre-determined period should be dropped from the apprentice course.

To insure a successful conduct of apprentice training the apprenticeship training system on a railroad should be in charge of a competent person assigned to this duty, who is generally known as a "supervisor of apprentices." The supervisor of apprentices should be supported by the active cooperation of the management.

One of the largest elements in a successful apprenticeship training course is the personal element; following up the apprentice's shop life and activities, assisting him where backward, and providing means whereby the apprentice is assured of sympathetic treatment in all of his relations with the railroad. This is followed out on individual railroads in different ways, such as a shop reviewing board composed of a shop superintendent or master mechanic, general foreman, department foreman and instructors, who meet periodically to discuss and pass upon the merits and progress of the apprentices.

A suitable record should be kept of the work and standing of apprentices. Diplomas or certificates should be awarded to those successfully completing the apprenticeship course.

Your committee has made no comment or recommendation as to compensation for apprentices, either in shop work or school work, as it is believed that this can be best handled by individual railroads in accordance with their conditions.

Summary of Replies Received to Questionnaire

(The questionnaire sent out by the committee was Exhibit A of the report. Exhibit B contained a summary of the replies received to this questionnaire from the various railroads. The following includes the questions asked in the questionnaire, together with the summary of replies received to each question.—EDITOR.)

1—Do you conduct a system of apprentice training?*

78 railroads reported *Yes* with a total of 13,859 apprentices.
18 railroads reported *No* with a total of 868 apprentices.
18 railroads did not answer this question.
73 railroads—replies not received.

2—About when was your system established?

Of the 78 railroads replying to this question:
5 railroads established apprentice training sytem prior to 1890.
18 railroads established apprentice training system 1890 to 1910.
41 railroads established apprentice training system 1910 to 1928.
14 railroads did not reply to this question.

3—Please indicate below in what trades you train apprentices and how many apprentices you are are training at the present time, helper and regular apprentices.

The replies indicate as follows:

Regular	10,574
Helper	4,133
Total	14,707

4—Give a brief description of the various classes of shop apprentices on your railroad (such as regular, first class, helper, etc.).

Replies cover regular apprentices and helper apprentices.

5—How long a period do the various classes of apprenticeship cover?

Regular apprentices, 4 years. Helper apprentices, 3 years.

6—Do you have a regular shop schedule for apprentices?

78 railroads reported *Yes*.
18 railroads reported *No*.
18 railroads did not answer this question.
73 railroads replies not received.

7—Attach a brief description of your schedule covering shop work for each trade and class.

Replies indicate that the universal method is to give apprentices frequent changes of work in accordance with the specified schedule arranged to suit the preferences and conditions of the individual road.

8—Describe briefly the method of selecting apprentices.

* The questionnaire did not ask for information relative to special apprentices.

All roads favor sons of employees, entrance examination, medical test, interview, and probation period.

9—Do you employ shop instructors, or do you assign some one to definitely supervise apprentices?

18 railroads reported *Yes*.
66 railroads reported *No*.
12 railroads did not answer question.
73 railroads, replies not received.

10—How many apprentices are taken care of by each shop instructor?

4 railroads report 15 to 20.
10 railroads report 40 to 100.
12 railroads report one instructor for all apprentices in the shop.
32 railroads report foremen give all instructions.
20 railroads did not answer this question.

11—Do the shop apprentice instructors devote their entire time to this work?

15 railroads reported *Yes*.
23 railroads report part time to instruction and part to supervision.
40 railroads report no instruction given except such as supplied by foremen and associate workmen.

12—If you do not employ shop instructors, state how the apprentices are taught the fundamentals of shop operation.

Where there is no resident instructor the foreman and associate workmen give instructions to the apprentices.

13—Do you give special technical instruction in the respective trades: (a) In an apprentice school of your own; (b) In cooperation with local public schools; (c) In cooperation with state institutions; (d) In cooperation with correspondence schools? Attach a brief statement of the practice followed.

30 railroads reported *Yes* (a).
22 railroads reported *Yes* (b).
15 railroads reported *Yes* (c)
28 railroads reported *Yes* (d).
26 railroads reported no instruction.
Note: Some roads have (b) (c) and (d).

14—What courses of study are covered in school work?

Company schools make up their own courses to suit their methods and conditions. Others have courses from public schools, state technical schools and correspondence schools. The courses usually cover sketching, mechanical drawing, shop mathematics, also instructions on mechanical appliances in use on the railroad.

15—Is school work conducted on company time or outside of regular hours?

35 railroads reported company time under pay.
9 railroads reported evening time under pay.
40 railroads reported home study correspondence course (individual and optional).

16—About how many apprentices will one school instructor normally take care of?

10 railroads report 10 to 20 per session.
4 railroads report 70 to 100 per session.
4 railroads report evening classes variable.
2 railroads report one instructor for all apprentices.
4 railroads report part time classes variable.
Others did not answer this question.

17—Do the apprentice school instructors devote all their time to this work?

5 railroads report *Yes*.
10 railroads report *No*.
5 railroads report part time traveling instructors.
6 railroads report instructors used on other work when not teaching school.
1 railroad reports school instructor also shop instructor.
Others did not answer this question.

18—From what source do you select your school instructors?

16 railroads reported graduate apprentices.
17 railroads reported shop draftsmen.

19—How are apprentices at smaller points taken care of?

8 railroads reported travelling instructors.
16 railroads reported transfer of apprentices to larger shops.
23 railroads reported instruction by foremen and associate workmen.
14 railroads reported no instructions.
17 railroads reported no apprentices at outlying points.

20—Do you award a diploma or certificate to graduate apprentices?

76 railroads reported *Yes*.
15 railroads reported *No*.
20 railroads did not reply to this question.

21—Total number of apprentices graduated during 1927?

Total of all replies, 4,103.

22—Give any other information in regard to your apprentice system you think would be of interest to the committee.

The replies from the roads contained statements as follows:

An apprentice board is created to supervise all features of apprenticeship.

Shop tools and supplies are furnished to apprentices at cost.

Social and athletic features are encouraged to foster vocational companionship.

Graduates are absorbed into the organization and work up to good positions.

One road mentioned 75 per cent of all graduates still in the service. Special features of instructions with regard to mechanical devices are used to arouse interest and stimulate progress.

Free scholarships are awarded to apprentices for meritorious service.

Apprentices attend lectures in air-brake car and other special features.

Three railroads said improvement of apprentice system is now under consideration.

One road said its system is the best known.

Several roads said satisfactory results are being obtained.

There is a general interest in the training of apprentices as a cooperative plan. Many worthy boys are given an opportunity to become proficient in the business. The company is benefited by having competent potential employees readily available to meet the requirements.

(Exhibit C included typical schedules for the shop training of machinist apprentices, electrician apprentices where traction work is and is not involved, boilermaker, blacksmith and tinsmith apprentices. It also included typical schedules for car apprentices in shops where both new and repair work is performed, and in shops where repair work only is done; plumber and pipe fitter, carpenter and cabinet maker, patternmaker, moulder, upholsterer and painter apprentices. The total time required for the completion of each schedule is 48 months. Exhibit D gave typical outlines of the school work for apprentices in the machinist, electrical, boilermaker, pipefitter and blacksmith crafts.—Editor.)

The report is signed by F. W. Thomas (chairman), supervisor of apprentices, Atchison, Topeka & Santa Fe; C. W. Cross, supervisor of apprentices, New York Central; A. H. Williams, supervisor of apprentices, Canadian National, and O. N. Edmondson, master mechanic, Pennsylvania.

Discussion

C. W. Cross (N. Y. C.): A careful study of the replies to the questionnaires submitted to the member roads indicates deep interest in the subject of training apprentices, this interest being doubtless influenced by the need of extending the training to railroads which do not have an adequate plan of training young men to be mechanics.

The object of an apprenticeship system is to develop carefully selected young men for the purpose of supplying leading workmen for future needs with the expectation that those capable of advancement will reveal their ability and take places in the organization for which they are qualified.

A. H. Williams (C. N.): This is a great work and a work that I think railroad companies will have to give

more attention to, so that they can place in their shops sufficient mechanics to take care of the number of men that leave the service and retire. Regarding the cost, some roads adopt one system and some another but I think that whatever the cost, within reason it is money well spent. The boy, when he is first placed in the shop, is an expense, but in a very short time, with proper supervision, he will be an asset. The old method of placing a boy in a shop and leaving him to work out his own salvation, as probably most of you know, is not the best way.

Mr. Brazier (N. Y. C.): This paper is very interesting. I served my time as an apprentice 55 years ago, and the last gentleman who spoke told of his impression, and I want to say to you that when an apprentice grows up on your road and your officers take an interest in him and in his daily life, you have a better, more loyal man.

In selecting apprentices, it is a wise idea, if you can to get college graduates along with the other boys. I am sorry to say that I am not a college man, but I have had a good deal to do with them. I would like to see the college boys recruited along with the other boys.

The report was accepted with thanks to the committee.

Report on Automotive Rolling Stock

C. E. Brooks
Chairman

At a meeting of the Automotive Rolling Stock Committee of the A. R. A. held in Chicago, March 5, 1929, it was decided that a report covering rail cars should not be submitted this year. This action was decided upon for various reasons.

During the last year the status of the unit rail car has been more or less in a state of flux, and there appears to be a marked tendency on the part of a considerable number of railroads toward cars equipped with engines using distillate or some form of fuel other than gasoline. There are various reasons for this, the most important perhaps being the better price at which the lower grade fuels can be procured.

Efforts, extending over several years, have been made by users of rail cars to utilize a lower grade of fuel in the form of distillate and while the results in the midwest have been very promising, the same cannot be said of the experience of the eastern railways. The forms in which distillate, so-called, are obtained in different parts of the continent, vary to such an extent that a very difficult problem is presented. This problem seems to resolve itself into which is the most suitable type of auxiliary apparatus for its most efficient and satisfactory utilization. With an increasing number of rail car units on which distillate is being experimented with, defects on present equipment should be rapidly eliminated and it is believed that much additional and constructive information will be forthcoming this year. We believe that the accompanying individual paper on "Distillate Rail Cars on the Union Pacific," by A. H. Fetters, general mechanical engineer of the Union Pacific System and a member of our committee, will be of great interest and help.

The use of Diesel engines in rail cars for passenger service has been confined entirely to one railroad. Figures covering the operation of these units have been published at various times during the past several years and it is not thought that any additional data at the present time covering these cars will convey any further information.

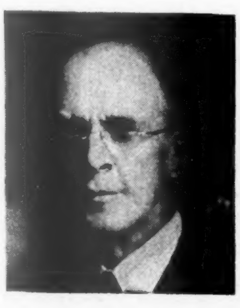
Orders have been placed by several different railroads for a number of Diesel-engined units and these are all expected to go into service in the very near future. By next year comparative figures from several roads, for this type of rail car will be available, which will give a much more comprehensive picture of the Diesel engine development than is now obtained.

For these reasons this committee has thought best to postpone their report until next year. By that time it is hoped that the results of the many developments now under way will have taken some definite form which can be made the basis of a report containing proved conclusions. It is also our hope to secure, for the last six months of 1929, operating cost data from a number of large users of unit cars and to present this in such form as to be useful to those interested.

The report is signed by C. E. Brooks (chairman), chief of motive power, Canadian National; B. N. Lewis, mechanical superintendent, Minneapolis, St. Paul & Sault Ste. Marie; F. P. Pfahler, assistant to chief of motive power and equipment, Seaboard Air Line; F. K. Fildes, assistant engineer, Pennsylvania; A. H. Fetters, general mechanical engineer, Union Pacific, and P. H. Hatch, engineer of automotive equipment, New York, New Haven & Hartford.

Distillate Rail Cars on Union Pacific

By A. H. Fetters
General Mechanical Engineer, Union Pacific System



A. H. Fetters

The use of distillate fuel is of general interest to railroads operating motor rail cars, primarily because of inherent difference in the price of distillate and gasoline, this differential being further increased by the high tax on gasoline which in some states is nearly equal to the price of the distillate fuel.

In addition to this advantage of lower cost, the fire hazard is reduced, there being no gasoline in the engine room, except while warming up the engine.

Because of this interest and the fact that the Union Pacific pioneered the development, and is the largest user, Mr. Brooks has requested this paper covering the use of distillate fuel.

Seeking cheaper operation of motor cars, the Union Pacific in 1914, collaborating with a local manufacturer, started the development of suitable carburetors to use low grade fuel on their 200- and 300-hp. McKeen cars.

Two years' experimenting preceded placing the first car in successful service with kerosene fuel, and by the end of 1918 all McKeen cars had been converted. Kerosene was used until 1922 when distillate was substituted because of its lower price, and all these cars have operated continuously since that time on this fuel. The economies gained may be illustrated by the following example, with factors close to actual operating averages: Car mileage per month, 4,000; miles per gallon of fuel, 2.3; total fuel required, 1,740 gal.; differential in cost of distillate compared with gasoline, 8 cents per gallon.

Making a liberal allowance for gasoline for starting, out of the total fuel at least 1,600 gal. will be distillate, which at the differential of 8 cents represents a yearly saving per car of $1,500.

In the case of the gas-electric cars with high-speed engines, these economies were at first partially offset by increased cost of lubrication, but recent improvements have resulted in a per-

formance comparable with the McKeen rail motor cars.

The distillate carburetors in use are of the fixed ratio type, consisting of a rotating air sleeve or throttle, and multiple fuel jets arranged to open successively in exact proportion to the area of air-sleeve opening. This maintains a fixed mixture ratio, and the use of multiple jets and high air velocity produces a fine atomization of the distillate. No heat is used to get a vaporizing action, except that which occurs after the charge has entered the hot cylinders.

Six carburetors are used one for each cylinder on six-cylinder engines. By attaching carburetors directly to the cylinders the intake manifold is eliminated, and the short path of gas traveled, being of low resistance, is conducive to high volumetric efficiency. This is further influenced by the air-fuel mixture which is not rarified by preheating.

Gasoline is used for starting and warming up, a change-over valve being provided for the selection of fuel.

The total number of distillate carburetor applications on the Union Pacific System is as follows:

Duff type distillate carburetors are applied to 25 McKeen mechanical-drive cars and 17 gas-electric cars, 11 of which have Winton engines and 6, Hall-Scott. Five additional gas-electric cars, equipped with Winton engines, have distillate carburetors supplied by the Electromotive Company.

The first gas-electric applications were made in the early part of 1927 to Winton engines. The first applications to Hall-Scott engines were early in 1928, these engines operating previously for several months on gasoline.

The five Winton engines equipped late in 1928 with Electromotive distillate carburetors are also of the fixed ratio type, one carburetor to each cylinder and having a single instead of multiple jet. A single idling carburetor is connected by a manifold to each main carburetor, this being cut out progressively as the main air sleeves are opened.

Definite reports on operation of these carburetors are not yet available as changes are being made to improve their performance, which is not quite satisfactory.

In general, the performance of the distillate cars is satisfactory, and, according to our 15 years' experience, superior to any gasoline cars we have operated. The motormen are partial to the distillate notwithstanding it requires greater skill and attention to details in operation, and the equipment must be maintained in better condition.

The application of distillate carburetors to the high-speed engines of the gas-electric cars, however, developed the problem of crank-case oil dilution, which does not exist on the McKeen equipment as force-feed lubricators are used for all bearings and cylinders, and the small amount of distillate which passes the rings is collected along with oil drippings in a small reservoir and sent periodically to reclamation plants. This dilution problem of the high-speed engines has largely accounted for the unsatisfactory experience with distillate equipment on eastern roads.

Conditions which Must Be Watched

To attain successful results, there are several factors which must be watched, both in the design of the equipment and operation. Neglect of any of these factors will result in excessive dilution, loss of power, and a sharp rise in operating cost.

The more important factors are:

1—Complete atomization of the fuel.
2—Correct engine operating temperature.
3—Control of detonation.
4—Piston and ring seal.
5—Definitely good ignition.
6—Proper lubrication.
7—Low exhaust back-pressure.

Many improvements have been made since the first applications to gas-electric cars with a view of perfecting these factors.

In connection with atomization of the fuel, improvement has resulted from a study of the contour of the passages in carburetor bodies and air sleeves, and improved fuel jets producing a preliminary break-up of the fuel as it leaves the jets. Some dilution resulted from a slop-over of fuel from the jets at the end of the intake period, which, with the next intake entered the cylinder in fluid form. Due to greater density, the fuel does not stop as quickly as the air column. This effect is now counteracted by an arrangement, which, by lowering the fuel level at open throttle positions, puts the fuel under a tension or increased resistance to flow, causing it to stop quickly at the end of the suction period.

The operating temperature of the engine is important—too cold an engine contributing to dilution and too hot to detonation. Thermostat valves are being applied in the water outlet, these being a heavy-duty type with several elements of the "Dole" type in each valve. With these thermostats, the engines warm up quickly and maintain a nearly constant temperature of about 180 deg.

Detonation is controlled chiefly by the water feed to the carburetors. This functions semi-automatically, water cutting in at a definite throttle position. A manual control permits cutting off water entirely when not required. Due to the water vapor, these engines are particularly free from carbon deposits, no removal being required between shopping periods. Detonation control is assisted by the mixture which enters the cylinders cold since the air and fuel is not preheated.

In converting from gasoline to distillate, it is usually necessary to lower the compression, a pressure of about 65 lb. being ideal.

Pistons and rings have received considerable attention. Aluminum alloy pistons are advantageous because of the reduction of the central hot area. Sizes up to 10 in. diameter are in service on the distillate engines. Rings of various types and materials have been tried. "Electric-Steel" rings, two 5/32 in. wide in each groove, are very satisfactory and of relatively low cost. The seal is good and the service life of rings and cylinder walls is longer than with cast-iron rings. In a few instances excessive dilution has been checked by substituting these rings for the ordinary types.

Other important engine details require consideration. Intakes should be on the opposite side from the exhaust to permit satisfactory carburetor installation. Portage to intake valves should be direct and free of pockets producing eddy currents. Valves should be timed to avoid a back-puff through the carburetors. Adequate crank case ventilation removes vapors which otherwise condense to the detriment of the oil. Bearings should be liberal and crankshaft balanced to obtain a low unit bearing pressure suitable for diluted oil.

Better ignition equipment is a present need for rail-car engines. It should be more substantial and permit of accurate adjustment. The several spark plugs in each cylinder, usually four, must have the firing period accurately synchronized and the gaps uniform. A serious fault in the ignition causes an increase in crank case dilution and reduced power output.

Effect of Dilution on Lubrication

Since dilution is the major problem encountered with distillate engines it follows that an important phase of operation is a close watch and changing of the lubricating oil at proper intervals.

No definite mileage is established per change of oil, this being governed by the rate of dilution. Mileage at the present time varies from 300 to 600, which is an increase over that obtained at the start with the high-speed engines.

Excessive lubrication costs which would otherwise result from the frequent oil changes are counteracted by reclamation of the oil. Six reclamation plants have been established at locations convenient to servicing points and the oil removed from crank cases is restored to its original condition or better at a fraction of the cost of new oil. Oil is now being reclaimed at approximately 17 cents per gallon.

The oil, when removed from crank case for treatment, shows from 10 to 30 per cent dilution and the recovery is about 65 per cent of good oil and 35 per cent of heavy distillate. The latter is used in locomotive cleaners, for penetrating oil, etc.

Oil radiators of liberal size have been applied to all cars, the independent cooling circuit having an engine-driven pump separate from that supplying oil to the bearings. Cooling controls the viscosity of the diluted oil. This cooling function is semi-automatic. The thinner the oil, the more effective the cooling, and when cold and heavy a portion of the oil bypasses the radiators through an automatic valve.

Cooled oil contributes to detonation control by cooling the central hot area of the piston, also reducing the carbonization of oil on the underside of the piston.

Eliminating excessive exhaust back-pressure is imperative regardless of the fuel used. This is to prevent burning of the

exhaust valves and seats, and rapid deterioration of exhaust pipes.

The Union Pacific design of light-weight cast-iron pipes causes little back pressure, remains relatively cool, and is reasonably quiet. These pipes weigh no more than similar pipes of steel, but withstand heat better.

A very satisfying fuel feed system has been developed for distillate burning cars, which is equally suitable for gasoline. Electrically driven rotary pumps of the "Viking" type deliver fuel from the tanks directly to small reservoirs on the carburetors, excess fuel overflowing back to the tanks. Relief valves on the pumps maintain a pressure of 2 to 5 lb., depending on the lift of the fuel above the pumps. One pump is provided for each fuel.

Floats and valves are eliminated from the carburetors, these parts previously requiring frequent adjustment and replacement. Pumps are more reliable than the vacuum system, and eliminate the fire hazard of the pressure feed. No fuel is stored in the engineroom, and the small quantity in the carburetors returns quickly to the tanks when the engine stops.

Large strainers and water separators are provided which, with the continuous movement of the fuel, prevents freezing of fuel lines. It is noted that with the elimination of air pressure on the fuel but little water accumulates in the tanks.

Operating Results

It has been the aim of this paper to tell what has been accomplished with distillate fuel, elaborate statistics being purposely omitted. However, the test performance of a new Hall-Scott equipped car is interesting, because, while it excels average performance, it indicates the progress made and possibilities of the fuel. The temperature during the test averaged about 5 degrees below zero.

Length of round trip (2 days)	550 miles
Fuel used, round trip	240 gals.
Oil put in crank case	14 gals.
Diluted oil removed	14 gals.
Percentage of dilution	26 per cent
Lubricating oil reclaimed	9 gallons

This indicates a dilution equal to 1½ per cent of the fuel used and that 3.7 gallons of lubricant was consumed and replaced with distillate.

The 26 per cent dilution in the best lubricating oil does not approach the danger point in these engines with their liberally proportioned bearings.

The fuel performance of 2.3 miles per gal. is better than average, but may be accounted for by fact that the equipment is new, of latest type, and in best condition. Also some long grades, downhill in the direction of the heaviest traffic are favorable to low fuel consumption.

The car used in the above run weighs 102,000 lb. and pulls an 85,000-lb. trailer.

The average miles per gallon of all cars during the year 1928 is as follows:

McKeen type cars	2.3 miles
Gas-electric cars	1.7 miles
Average of all cars	2.1 miles

The McKeen cars are lighter and do not pull heavy trailers as do the gas-electric. On a weight basis, the fuel consumption of the gas-electrics compares favorably with the direct mechanical drive McKeen cars.

Specifications for the distillate used by the Union Pacific are given for comparison with that available in other districts. Trade name "Prime White Distillate," supplied by Wyoming refineries; specific gravity .84, corresponding to 35.9 deg. A. P. I.; distillation—initial 362 deg. F.; end point 614 deg. F.; viscosity 34, at 100 deg. (Staybolt); heat value, 18700 B. t. u. per lb.

It is possible that the extent of the use of distillate will be determined largely by the availability and price of suitable grades in various districts. Unquestionably, however, either distillate engines or a comparable form, such as Diesels using low grade fuels, will ultimately supersede the gasoline engines. The heavy fuels will always remain at a lower price level than gasoline; no utility is sacrificed by their use, and they are gas tax free.

With interest awakened in the use of the heavier fuels, development is encouraged and undoubtedly new devices of various types will be proposed. Already a number of new arrangements are in experimental operation. For some of these using the vaporizing principle, no particular success is predicted in rail car service, wherein the power requirements are severe and subject to constant variation. Vaporizing or "Hot Spot" types have been tried many times and results have always proved disappointing on rail cars.

Developments with the atomizing type carburetors contemplate the complete elimination of gasoline for starting and warming up of the engine. This will further increase the economies of these engines, and remove such fire hazard as still exists from the presence of small amounts of gasoline in the engineroom at starting periods and from the storage of this fuel under the car.

After 15 years of experience in operating rail motor cars with low grade fuel, we have faith in the future of the distillate engine, and we will continue to contribute our experience toward its perfection and general use.

From time to time we have contemplated the introduction of Diesel type rail cars, bearing in mind the successful operation which some of our neighbors secured with this type. Each time, however, our studies have indicated that we are practically as well off in actual operating costs, and better off from the standpoint of initial investment and weight.

Discussion

Mr. Demarest: I have listened with a great deal of interest to Mr. Fetters' paper in connection with the Union Pacific's experience with distillate oil burning engines. The question of the so-called gas-electric cars and non-paying steam service is a pretty vital proposition for all of us.

We have numerous steam service operations that run heavily in red ink, and we have eliminated all the non-paying service that the state commissions will let us take off, and we have been searching for a substitute unit for steam which will at least save us money by reducing the loss. We tried out recently a development which seems to me to have some practical promise. The application of steam engines for purposes of this kind has always been restricted, due to the fact that no one has got a steam generator which was adequate, and could be placed in a small space. The International Harvester Company has apparently developed such a steam generator, and the installation was interesting to me, because I can see that if the generator is elastic, the question of limiting power is in a measure met. That leads to the question as to whether it will not eliminate some of the smoke at large terminals.

Regarding fuel consumption, we have, of course, used a steam unit, with fuel very much lower in grade than gasoline. Buying gasoline in carload lots, it costs approximately 10 cents a gal. We used with the steam engine a fuel called furnace-gas oil at about 6 cents a gal. because we could get it conveniently at that time. Our understanding is that the steam generator would use a still lower grade of oil called gas oil, at 4 or 4½ cents a gal. Even with the excessive fuel rate of the furnace for the steam engine, the oil cost was much lower than gasoline. I was much surprised to hear that you average 2.3 miles to the gal. with your distillate, particularly when you made the further statement that you carried a 185,000-lb. train. Am I correct?

Mr. Fetters: One car.

Mr. Demarest: It was a single-unit car, and not a car with an ordinary trailer?

Mr. Fetters: Yes.

Mr. Demarest: In our new service, the motor-car unit weighs approximately 90,000 lb., and ordinarily we carry a standard trailer that weighs 96,000 lb., so that our gas consumption runs about ¾ gal. to a mile, which is not nearly as good a figure as you gave, but it does not seem to me that we have yet reached the ultimate of experience with these motor-car units. I know that the

Canadian National, is spending a great deal of money on the development of the Beardmore Diesel engine, and we have got three cars that are said to have 325 h. p. I don't think we are safe on any engine that will develop less than 500 h. p.

Mr. Fetters: We have not reached the maximum horsepower of the gas-electric engine yet. The Rock Island is operating three cars with dual 400-hp. units. They are operating successfully, and I see no reason why a unit of 500 hp. is not advisable. I agree, however, that when greater power is required, we should seriously consider the Diesel engine.

Report on Electric Rolling Stock

W. L. Bean
Chairman

The report includes five subjects. The first of these is a description of the Pennsylvania-Philadelphia Suburban Electrification. This is not included in the following abstract as a separate article on the same subject is included in this issue of the *Railway Age*. Part 2 concerns "The Problems and Solutions Incident to the Ventilation of Electrical Apparatus on Cars and Locomotives." It is included herewith in full. Part 3 describes an extension to the electric-locomotive repair shops of the New Haven at Cos Cob and is also included in full. The fourth subject concerns "A Standard Method of Rating Electric Locomotives" and is being studied by the committee, but because of difficulties involved, no conclusions are included in the report. Part 5 tabulates the locomotives of the world placed in service during the year 1929 and supplements the compilation of data included in the 1928 report. This tabulation, which is not included in the following abstract, lists 144 locomotives, including 14 for the United States, 2 for Mexico, 3 for Brazil, 22 for British India, 7 for Japan, 56 for France and 40 for Italy.

Ventilation of Electrical Apparatus on Cars and Locomotives

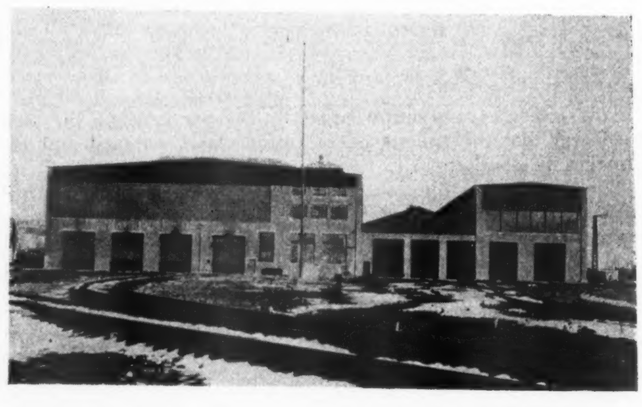
In all electrical equipment, heat is generated by the passage of current. If this heat is not dissipated fast enough, it accumulates and the temperature reaches a point which will damage the insulation. When liberal design is possible, the

View showing four old type monitor skylights over portion built some years ago, and the new continuous type with ventilators furnished on new extension—the continuous type gives a great deal more light in the section it is on and to the main building adjoining

amount of heat generated will be small, and the natural radiation from the surface of the apparatus will be sufficient to prevent excessive temperatures, many of the older types of equipment being in this class. On railways rolling stock, however, space and weight are at a premium and design is restricted thereby. The demand for more and more power on cars and locomotives has made design progressively more difficult, and it is often necessary to resort to artificial means for cooling the electrical equipment. Since air is the medium to which the heat must be transferred, all systems ultimately resolve themselves into one of air circulation, even though an intermediate medium, such as oil, may be employed in addition.

The problems involved are essentially of two characters: One, to provide the necessary means for causing the air to circulate and to conduct it to and from the apparatus within spaces which are usually limited; the other, to separate out from the air, as much as possible of the dirt, snow, water and other foreign material which it may contain and which is injurious to the apparatus. With the immense amounts of air required on large electrical locomotives, both these problems become of major importance.

The obvious method of securing the desired circulation of air is the use of a power driven fan. In some cases of rotat-



New Haven electric locomotive shop—The five track section on right is the extension added in 1928—It is used as inspection and finishing shed for locomotives and cars and for overhauling multiple,-unit cars

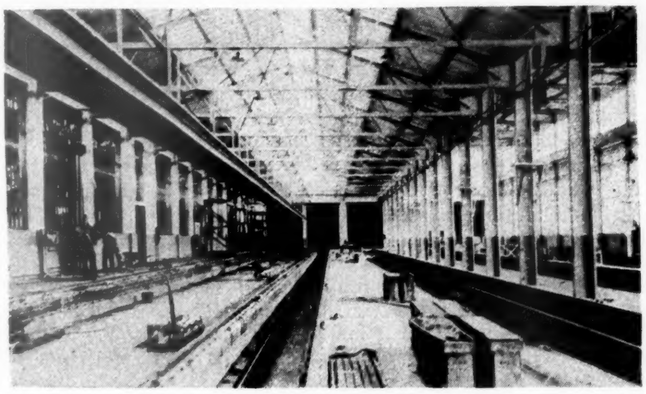
ing apparatus, the fan may be attached to the revolving part within the apparatus itself. In other cases such as transformers where there are no moving parts, or in the motors of large locomotives where the rate of cooling must be high and continuous, fans driven by independent motors are generally used.

For apparatus in which the design is not too restricted, such as most direct current car motors, the self-ventilated arrangement is suitable and admirably simple. The fan is built into or attached to the armature, and revolves with it. The motor frame may be entirely enclosed, to keep out dirt, etc., in which case the fan circulates the air within the motor, forcing it over the heated portion and into contact with the external shell through which the heat is conducted to the outside air. If this method is insufficient, openings, usually at each end of the motor, may be provided. Cool outside air is drawn in through one set of openings and the heated air is expelled through the other set. Since this arrangement draws in a certain amount of dirt, the inlet openings should be designed to reduce the ingress of solid material as much as possible. In winter, snow conditions may prove serious to motors located close to the track, since, in addition to the snow which may be drawn in with the air, packed snow in large quantities may be

forced into the motor. It is customary to provide means for partly or wholly closing the openings in winter, which of course reduces the ventilation, but since all temperatures are low in winter, less ventilation is required.

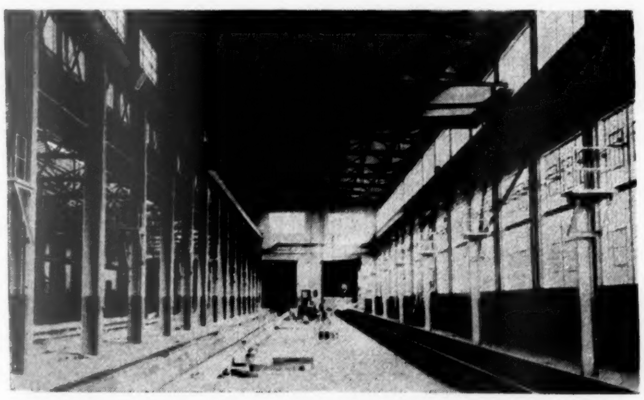
Self-ventilation provides cooling in proportion to the speed of the apparatus itself, and unfortunately in the case of motors, the rate of heating is usually highest when the speed is low. The arrangement is not suitable where continuous ventilation is required, or where a considerable proportion of the movement is slow. For special apparatus which runs at constant speed, such as phase converters or motor generators, it may be made very effective.

The real problems are encountered where such large amounts of air are involved as to require forced ventilation. In such cases, blowers of conventional design, driven by motors, are



Interior view under roof equipped with continuous skylight

generally employed. The system may involve pressures, or suction, or both. Pressures, up to six or eight inches of water are used. Ordinarily blowers are located inside the cab of locomotives, or underneath the body of cars. In locomotives, several blowers may be required. These, with their motors, are large in size, and if remote from the apparatus which they ventilate, require air ducts, also of large proportions. Thus the space factor for ventilating equipment becomes highly important. Individual blowers for different pieces of apparatus reduce the space required for air ducts, and also the pressure losses therein, but blower units are large and of irregular shape, and when their location is governed by proximity to the apparatus which they ventilate, their installation may be difficult. The number and arrangement of blowers to be used will depend entirely on conditions existing on the particular layout being considered, giving consideration to the space available, and to the segregation desired in case of failure.



View showing 30-ton crane, inspection pits, aerial inspection platforms (Crow's nests) and depressed floor

To decrease the size of ventilating equipment, high air velocities are employed. It is usually impossible to make duct connections without change of direction, and much loss of pressure may result if the effect of suddenly changing the direction of air, flowing at high velocity, is not appreciated. Ducts or other connections should be as short, as large in section, and as straight as possible. Where bends are necessary, they should be of the greatest possible radius. Vanes properly arranged inside a bend may be employed to materially reduce loss of pressure. Consideration should be given to using frame members as air ducts, modifying them if necessary to give best results.

When provision must be made for relative movement between parts, as in the case of motors mounted on a swivel truck, flexible ducts must be employed. These are usually of canvas, accordion pleated. They are usually treated with some water-proofing material such as linseed oil, but there is a demand for something which will be preservative, flexible, and at the same time fireproof. Canvas ducts are not infrequently set on fire by brake shoe sparks or motor flash-overs.

A ventilating system should be so designed that the air supply can be stopped quickly in case of fire inside the apparatus being ventilated. Modern insulation is to a considerable extent non-inflammable, and a fire, if not supplied with air, will soon smother itself; but if blown by the forced ventilation, the fire will continue and result in serious damage. Provision should also be made for cutting off the air from defective apparatus, and transferring it to other apparatus which may possibly be used to a higher capacity.

The problem of freeing the air from dirt and snow, especially the latter, is serious. Either one is detrimental to electrical equipment and should be excluded. The combination of water from melting snow, with dirt already in a

View of new extension showing large amount of natural lighting provided by the large windows

motor or transformer, is almost sure to cause trouble. The quantity of snow involved, during blizzard conditions, in a locomotive requiring 30,000 to 40,000 cu. ft. of air per minute, is enormous. In addition to locating intakes where they will be exposed to the minimum of dirt or snow, and to protecting them by louvers so designed as to deflect the dirt or snow as much as possible, two general methods of separation are employed: (1) Use of a settling chamber where the air moves at a low velocity and permits solid matter to settle out by gravity; (2) Some form of filter.

On slow moving locomotives, intakes located under the floor of the cab will probably be less subject to snow than elsewhere. They will, however, be exposed to road dust and particularly to dust when wheels are sanded. On high speed locomotives and cars, intakes well above the tracks are probably preferable, to avoid snow or dirt which is swirled up by the movement. Care must also be given in locating intakes to prevent hot air discharged from the apparatus, being drawn in and recirculated.

In locomotives, the cab is often used as a settling chamber. This is quite satisfactory if too much air is not required. In any event, the intake openings must be located to be as far from fan suction as possible, and louvers should be arranged to decrease the velocity of the air at once after it has entered the cab. Sometimes the cab windows are used as intakes, being opened or closed by the engine crew according to weather conditions, to give the best results. Snow should be caused to settle out in aisles where it will not damage apparatus and where it can be shoveled out if large quantities accumulate. Reduction in the amount of air used in cold weather should

be considered as a possible help, but since this may also affect the distribution of the air within the apparatus, the quantity of air should not be reduced without study of effects. Re-circulation of a part or all of the air in cold weather may be used to advantage in reducing the amount of air, and consequently of snow, brought in during winter months.

To keep out dust and snow, filters of various types are sometimes used. These are in the form of screens of coarse mesh cloth, or else some one ot the commercial types of oil covered metal screen filter or modifications thereof.

The cloth screen should be arranged to give the maximum area. Wedge-shaped cloth bags on screen supports make an effective arrangement. The cloth should be open meshed to permit the passage of air, but fuzzy to catch the particles of dirt. A wool cloth, known as "scarfing" and similar to bunting, has been found most suitable. Cloth screens are very effective, but fill up rapidly with the dirt they entrap, and restrict the air. They should be of as great area as possible, and so arranged that they can be readily cleaned by blowing, by vacuum, or by removing and beating. They must be enclosed to protect them from mechanical injury and from any source of fire. The enclosing box is liable to become filled with snow during winter weather, and consideration should be given to preventing this.

Oil covered screen filters of commercial types are very effective in stopping dirt and snow, but due to the great quantities of these substances encountered, particularly under a car rapidly lose their effectiveness and obstruct the air. They are also very difficult to clean. If used, much more than the usual area should be provided to lengthen the cleaning periods. They are also subject to fire and must be protected from brake shoe sparks and other sources of ignition. A modification of this type of filter, consisting of a number of layers of coarse screen or expanded metal, dipped in oil, is giving good satisfaction when applied to the fan suction of locomotives. It is not as efficient as a commercial filter, but retains a great proportion of the dirt, and may be cleaned by burning off the dirt and oil.

Ventilation of electrical equipment on electric rolling stock is, therefore, a subject of major importance. With increasing demands for concentrated power, the ventilation requirements become more severe, and the difficulties increase. There is no possibility of framing hard and fast rules, and the individual conditions of amount of air required, arrangement of apparatus, weather to be encountered, etc., coupled with some knowledge of the performance of ventilating apparatus, must govern each design.

The Extension to the Locomotive Repair Shops of the New Haven

The New York, New Haven and Hartford Railroad completed this year an extension to the Van Nest repair shops which the members of the Committee on Electric Rolling Stock visited just after completion. This addition is 106 ft. wide by 375 ft. long and contains five tracks. The building is of steel and brick construction with a fireproof roof. The greatest possible amount of window space has been provided along the sides of the high section. Over the low section, a continuous skylight admits all the light possible. This is a decided improvement over the Monitor type of construction and is recommended for the consideration of any members erecting new shops. The doors are electrically operated and protected by limit switches so that they are practically automatic. Air heaters equipped with electric driven fans are provided in addition to radiators located in the pits. This provides good heat and is well distributed. It will be noted that the building is well equipped with ventilators. The electric lighting is very complete and outlets are provided so that extension cords can be plugged in at convenient intervals. The high section is served by a 30-ton crane with a 5-ton auxiliary hook. This enables the removal of pantagraphs, air tanks, reservoirs, etc., without the necessity of moving the locomotive into the main shop.

The new extension, like other parts of the shop, is provided with outlets conveniently spaced for compressed air, Selas gas, oxy-acetylene, electric arc and 550-volt direct current test line. Easy access to the roof of the locomotives and cars has been provided by means of aerial platforms and so-called crow's nest, which can be seen in one of the photographs.

The floor is depressed 15 in. below the top of the rail to facilitate working on the trucks and running gear. Wide, deep pits, running the full length of each track, except for a distance of about 12 ft. on each end, enable inspection and work on trucks, motors and other apparatus.

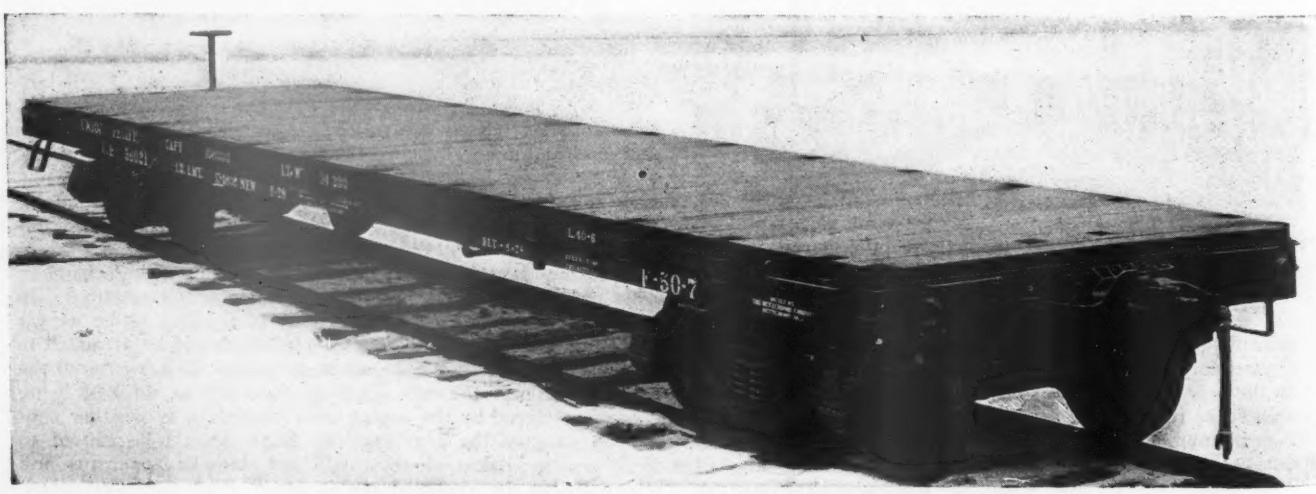
The building, formerly occupied as a finishing and inspection shed, has been converted into a paint shop. Here adjustable scaffolding has been provided and also metallic shelving so that the parts of the car removed during the painting operation can be neatly and efficiently stored and handled. These parts are seat backs, cushions, lamps, curtains, window sash, doors, hardware, etc. Special boxes, shelving, tanks, etc., have been provided for keeping stencils, brushes, paint, etc., in a room adjoining the paint shop.

A vacuum cleaning system has been installed. It consists of a fixed exhauster driven by a motor. Two pipe lines run the length of the shed so that a car on any track can be reached by attaching a hose.

The complete facility, of which this extension is a part, handles general overhauls and heavy running repairs on electric locomotives and multiple unit cars. In addition, the monthly inspections on freight locomotives and switcher locomotives are handled.

The report is signed by: W. L. Bean (chairman), mechanical manager, New York, New Haven & Hartford; J. H. Davis, chief engineer electric traction, Baltimore & Ohio; J. V. B. Duer, electrical engineer, Pennsylvania; R. Beeuwkes, electrical engineer, Chicago, Milwaukee, St. Paul & Pacific; R. G. Henley, superintendent motive power, Norfolk & Western; H. A. Currie, electrical engineer, New York Central; E. W. Jansen, electrical engineer, Illinois Central; J. W. Sasser, superintendent motive power, Virginian and L. C. Winship, electrical engineer, Boston & Maine.

The report was adopted without discussion.



50-ton flat car built for the Union Pacific by the Bettendorf Company

Great Advances in Mechanical Department

By W. M. Jeffers
Vice-President, Union Pacific System, Omaha, Neb.

Wm. M. Jeffers

In a brief informal talk, W. M. Jeffers, vice-president in charge of operation of the Union Pacific System, addressed the members of the convention, paying a warm tribute to the efforts of mechanical department officers in effecting improvements, and particularly in promoting long locomotive runs with their attendant economies. Mr. Jeffers said in part:

"It is not just clear what I can say to you that might be interesting. Naturally, having come up through the ranks, I am interested in mechanics, and I am interested in the things that you men are thinking about. I am impressed with two things, always, about a railroad. It is the most exacting business that there is. Men in other lines of business can go back and correct their mistakes or errors, but in the railroad business we cannot go back and correct errors at some future time as we would like to. Again, I am impressed with the fact that railroading is the one business that a man must learn from the other fellow. There is no course in universities or colleges, there are no text books from which a man can learn the railroad business. He must learn it from the other fellow. I take it that most of you men have come up through the ranks from apprenticeship and you know the game. You have learned from the other fellow in the same kind of work.

"I am impressed also with the fact that, particularly in the mechanical department, we have made the greatest advances. That is more true, I would say, in the last 15 or 20 years than in the years preceding. In the old days railroad men got in a rut, and what was good enough for the other fellow that went before was good enough for them. That is not as true in these later days.

"I find that mechanical men on all the railroads are seeking to effect improvements in connection with their respective departments. So we have the big, high-speed locomotive that is economical in fuel. We have the long locomotive run, and that is something that will save the railroads more than any one thing yet attempted—brought about entirely by the ingenuity of you mechanical men. Naturally, we fellows that have not learned the mechanical game must look to you men for improvements of that nature. I have been particularly impressed with the long locomotive runs. They save power and money and conserve time.

"I am interested in what you are attempting to do, and I want to compliment you on what you have done, and again suggest to you the advisibility and necessity for looking a long way into the future. When preparing reports and considering any subject, it seems to me important that you look as far ahead as possible. I want to say again that those responsible for the operation of railroads are relying on you mechanical men. We are more than pleased and more than happy to say to you that you have not only done what you were expected to do, but you have accomplished the almost impossible."

Locomotive and Car Lighting

W. E. Dunham
Chairman

The committee was directed to investigate and report on locomotive head-end train lighting, particularly for suburban service. The committee has also been investigating (a) the positive mechanical axle-generator drive and (b) revision of the present axle-generator specifications.

Head-End Train Lighting

Since the last annual meeting no substantial increase in suburban head-end train lighting has come to the notice of the committee. The present installations are operating very satisfactorily, both in regard to service and cost, and your committee feels that this method of lighting suburban trains has proved its reliability and economic value under suitable conditions.

The committee has given considerable study and thought to the subject of furnishing electrical energy for main-line passenger trains by means of a turbo-generator mounted on the locomotive and the use of a minimum size storage battery on each car.

The committee recognizes the difficulties encountered with the present system of axle-generator lighting due to the constantly increasing demand for electrical energy for the operation of current-using devices such as electric refrigeration, ozonators, toasters, cigar lighters, drink mixers, dish washers, pressing irons, radios, electric water coolers and heaters, and other various current-consuming equipment. The committee also recognizes the difficulties, particularly during winter months, with the belt-driven equipment in maintaining proper lighting service on cars in certain sections of the country, which is further reason for serious study and consideration of an electric-current system which will possibly obviate this difficulty.

The committee further recognizes that if a successful head-end system can be developed it may have great economic possibilities over the present axle-lighting system. The problem, however, has many intricate complications and is one that will require a great deal of study and slow progress is to be expected.

Positive Mechanical Axle-Generator Drive

It has long been recognized that the belt drive of the axle-lighting system has been the outstanding limitation in the reliability of this system, particularly in those sections of the country in which extremely cold weather, ice and snow are encountered. The committee therefore has been investigating the possibility of the direct mechanical drive for axle generators, such as would not be liable to failure under adverse weather conditions and loads which will retain the flexibility of the present axle-lighting system and permit of more efficient and larger generator capacities when needed.

There are several positive-drive equipments on test on railroads in the United States and Canada at the present time, some of which show promising results. After these equipments have been in service for some time the committee expects to be in a better position to judge the merits of these devices.

The committee recommends that Section "H," page 40, para-

graph "D" of the manual of Standard and Recommended Practices be changed to read:

The generator shall be safe to operate both electrically and mechanically at an armature speed of 1,800 r.p.m. for generators having a minimum full-load speed of less than 700 r.p.m.; and 2,500 r.p.m. for generators having a minimum full-load speed of 700 r.p.m and higher.
This value shall be known as the "maximum speed" in r.p.m. of the generator.

High-Speed Tests.—The committee recommends that Section "H" page 44, paragraph 16, be changed to read:

Immediately after temperatures have been taken in connection with the above heat tests the generator shall be operated continuously for 15 minutes at the full rated load, one-half of the time in one direction and the other half of the time in the opposite direction, at a speed of 1,800 r.p.m. for generators having a minimum full-load speed of less than 700 r.p.m.; and 2,500 r.p.m. for generators having a minimum full-load speed of 700 r.p.m. and higher.
This test shall be conducted with inspection covers removed.
The generator shall perform satisfactorily both electrically and mechanically at these speeds.

Locomotive Lighting.—It is also recommended that "Locomotive Lighting—Recommended Practice, adopted in 1920, revised in 1927," which was apparently omitted through an oversight, after having been approved by letter ballot as announced by Circular DV-559, dated October 20, 1927, be restored to Section "H" of the manual as covered on pages four to six, inclusive.

Recommendations for Future Work

The committee recommends that it be permitted to continue its investigation of (a) locomotive head-end lighting for main-line passenger trains and, (b) locomotive head-end lighting for suburban trains. It also recommends the continuation of the investigation and report of positive mechanical axle-generator drive.

The committee also recommends a revision of the schedule of incandescent lamps, appendix "C" and "H" of the manual and that consideration be given to the adoption of a standard lock and key for generator and lamp-regulator lockers for all cars used in interchange service.

The report is concluded with an acknowledgment of the committee's appreciation of the assistance rendered by the Association of Railway Electrical Engineers through its various committees.

The report is signed by: W. E. Dunham (chairman), superintendent car dept., Chicago & North Western; E. P. Chase, assistant engineer, Pennsylvania; H. A. Currie, electrical engineer, New York Central: E. Wanamaker, electrical engineer, Chicago, Rock Island & Pacific; E. W. Jansen, electrical engineer, Illinois Central; A. E. Voigt, engineer car lighting, Atchison, Topeka & Santa Fe; E. Lunn, electrical engineer, Pullman Company, and P. J. Callahan, supervisor locomotive and car electric lighting, Boston & Maine.

Discussion

Mr. Dunham: Almost daily your committee is being advised of new developments in the positive drive and also in the application of so-called head-end systems of electrical generation. That is one of the reasons why the committee has not felt that it was desirable or advisable to make any definite suggestions or recommendations at this time. We have felt that the best results would be obtained if we could keep in touch with these developments, so that when there is a little more uniformity in the practices and in the application of these various devices we can give some definite report as to head-end systems on both suburban and main line trains, and also some report or suggestions or advice on mechanical drives.

Chairman Smart: On the Canadian National, where we have one of the worst climates and worst snow conditions we are trying out direct drives. We are not in a position yet to state definitely the merits of the different drives. The chain drive is not a new thing, but it is giving us very good results. It is not a patented device. It is a sprocket on an axle with a chain. In the winter months we get the full output of the machine. This method is not as economical as the belt drive, but we do save in train yards by not having to charge batteries, because the car arrives with the batteries fully charged.

I think it is a good idea of the committee in recommending a universal type of key for all railroad car electrical lockers. Many railroads have their own keys for the switch lockers, which are placed in the hands of the trainmen or the switchmen. If cars go off the line, access must be provided to these electrical switch lockers.

Mr. Chambers: I want to ask in regard to this sprocket chain drive, or direct drive; whether any noticeable effect has been developed on the generator itself?

Chairman Smart: We have never noticed anything wrong with our generator, but we did get wear on the sprockets in the warm weather when we had dust and dirt.

Mr. Demarest: I don't want to discuss this excellent paper from a technical standpoint at all, but I do want to point out two things that have happened and caused more annoyance in train operation than anything else connected with electric lighting systems. One is the burning out of incandescent lamps. This committee has done excellent work, but I have not seen any place yet in the investigation where the question of developing a lamp which would give us more reliability and longer service has been pointed out. Our principal train detention is brought about, as far as the lighting system is concerned, by the failure of incandescent lamps. Another essential feature that also comes up is the matter of broken or lost belts. Some development of the direct drive is absolutely necessary to make that feature of equipment more reliable.

Mr. Nystrom: The Milwaukee has been slow in going into axle lighting equipment. However, we have two trains now fully equipped with axle lights. Last winter those two trains failed. We had to put on dynamo-baggage cars to light the trains. At the present time we are testing the 20-kw., Pyle-National steam-drive generator applied to locomotives. We have been testing the machines for about three months, so far with entire satisfaction. The main feature is the automatic turbo-generator which continually compensates for the varying electrical demands in the train. This promotes full battery charging without overcharge.

We have not yet experienced over two volts variation in the lamp circuits over the entire train length. The application is simple, and it should cost less than to apply the axle-light equipment. We have not had sufficient experience to know the ultimate outcome, but it looks good so far. The Milwaukee has the 64-volt system and there is no reason why a generator could not be applied having a standard of 110 volts. That would offer great possibilities.

A. E. Voigt (Santa Fe): If we go to the head-end system, every railroad in the country must go into it as a unit, or we will get into trouble with the interchange of cars. At the present time, since the axle-generator system has become so generally used on most of the railroads throughout the country, the railroads have reduced their train line wires to No. 2 copper, and to two wires per car. With the head-end system, it would necessitate having three wires to the car of No. 000 copper, in order to keep the voltage drop uniform throughout the train. Head-end lighting, in years gone by, has not treated our batteries as well as the individual axle-light system, due to the fact that it is difficult to have a number of batteries connected on a parallel line charged from the same source of power and delivering to each battery the proper amount of current that particular battery should have. Of course, it is possible

that some system might be devised to overcome this difficulty, but if we do not have better success than we have had in the years gone by, what saving we make on generator upkeep might be offset by battery cost and also automatic control on the individual unit.

At the last convention it was thought possible to do away with the batteries if we went to head-end lighting on a transcontinental train, but your committee is a unit in saying that we should have a battery on every car.

Even though head-end lighting might prove economical, we have an operation condition to contend with. I prepared a consist of Santa Fe train No. 21, leaving Chicago, in order to see just what would happen if we were to have a head-end generator on this train. No. 21 leaves Chicago with 16 cars, as a rule. At Streeter they cut out one diner; at Morrisfield they pick up a diner; at Kansas City they cut out a sleeper, diner, and three baggage cars; at Kansas City they pick up three baggage cars, a chair car and a refrigerator-express; etc. If we are going to operate a head-end system we should have all refrigerator-express cars wired for train line. With this frequent cutting in and cutting out of sleepers, the problem of good contact on train lines is a vital factor, and we know that with the present system we do experience poor contacts where porters and others put up the train lines. While some roads may be experiencing difficulty with belts, due to slipping, as a rule this period is a short part of the year. I can say for the Santa Fe that we are obtaining, including Pullman cars, an average belt mileage of about 80,000 per year. I realize that some roads have different problems than we have, and that is what the committee is wrestling with.

Mr. Rink: We have a number of suburban type coaches with four-wheel trucks equipped with clasp brakes using A. R. A. brake beams, which necessitates placing the pulley off center from the center line of the car.

I would like to know whether anyone has applied the mechanical drive to a truck under those conditions. We have experienced considerable trouble in the loss of belts because of brake beam safety clips having a tendency to creep off along the compression member. We found it advisable in such cases to weld the clip at a safe distance from the belt so that the belt will not rub against the chain. I think it is important to maintain the vertical clearance between the brake beam and the belt. We find that watching these features saves considerable belting.

P. S. Westcott (Pyle-National Company): Mr. Voigt has brought up some concrete problems which must be met in train lighting, but I have found in the final analysis that many of them disappear in thin smoke when they are analyzed. One problem had to do with the interchange of cars, and, in that connection, Train No. 21 on the Santa Fe was mentioned. It has been my experience that every road in the country, of any size, has a number of unit equipments; for example, the Chief on the Santa Fe, or the Empire Builder on the Great Northern. These unit trains have very little interchange of cars, thus affording an excellent opportunity to install the unit train lighting system and get the resultant economy. It is true that it would be costly to change old lighting equipments all over the country to a form of head-end lighting, but the attendant economies are such as to more than compensate for the conversion expenditure. This is being demonstrated by every day service tests.

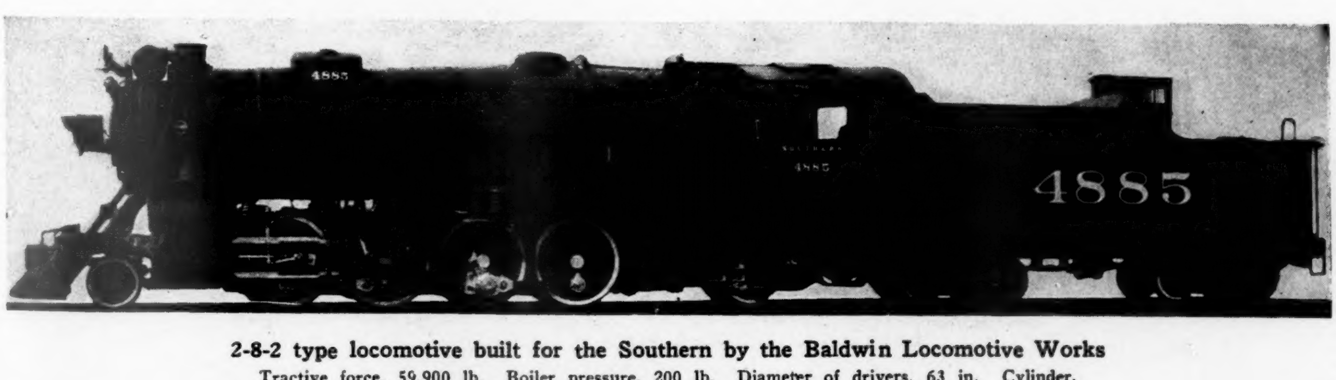
Long before I was born, the American Railway Association was formed and solved problems many times more serious than the present lighting problem, and I believe it has been the history of the association that if the members set their minds to do something, it is not very long before it is accomplished. It does not seem to me that these objections to head-end lighting are real stumbling blocks. Many of the limitations that were cited have to do with the former head-end system, which, as admitted by almost everyone connected with it, has never been developed. It has just existed.

When talking of train line wire sizes and methods of application, it is true that some difficulties have been experienced in the past, but, with proper design, it is entirely feasible to overcome these difficulties. Many of them have already been overcome in actual railroad operation.

Speaking of axle-generator belt slippage, practically every northern railroad has had in the past winter an exceedingly difficult time with axle-generator lighting operation. I can name four northwestern railroads whose representatives say that trains lighted under the old baggage-car head-end system at it worst never were dark, and were dark for the first time under the axle-lighting system this last year. The train, described by Mr. Nystrom as being lighted from the locomotive, carries an axle-lighted diner equipped wth a heavy-duty train line, as are all Pullman cars assigned to the Milwaukee. In at least a dozen instances this axle-lighted diner, through belt loss or slippage, failed electrically so that meals were served by candle light, and all other cars in the train continued to be normally lighted from the baggage car as usual. The contrast was striking in that case.

It is sincerely hoped that the work of your car lighting committee in investigating the lighting of trains as units, from the locomotive, may be carried diligently forward, as the data and information on this subject secured during the past few months seems to offer great possibilities.

On a motion by Mr. Purcell, the report was accepted.



2-8-2 type locomotive built for the Southern by the Baldwin Locomotive Works

Tractive force, 59,900 lb. Boiler pressure, 200 lb. Diameter of drivers, 63 in. Cylinder, diameter and stroke, 27 in. by 32 in. Weight on drivers, 241,800 lb.

Report on Locomotive Design and Construction

W. I. Cantley
Chairman

Your committee has, during the year, given further consideration to the following subjects:

Standardization of Fundamental Parts of Locomotives. (Exhibit A)

Exhaust Steam Injectors and Exhaust Steam Feedwater Heaters. (Exhibit B)

Use of Back Pressure and Initial Pressure Gages, including Automatic Cut-off and Control—Reduction of Back Pressure on Locomotives. (Exhibit C)

Standardization of Pipe Unions of the nut and nipple type. (Exhibit D)

Tender Tank Hose. (Exhibit E)

Springs and Repairs to Springs. (Exhibit F)

Formula for computing Tractive Effort of Locomotive Booster. (Exhibit G)

The report of the sub-committees on these subjects is contained in the accompanying exhibits.

Exhibit "A"—Standardization of Fundamental Parts of Locomotives

The work assigned to the subcommittee relates to the following subjects:

Crossheads.
Guides.
Methods of lubricating crossheads and guides.
Cylinder heads.
Knuckle joints for side rods.

In collecting information the subcommittee has received recommendations from two locomotive builders and 21 railroads operating in all parts of the United States and Canada, and the following recommendations are based upon this information:

Crossheads and Guides

All the parties addressed, except two roads, recommend two-bar guides and crossheads of the so-called "alligator" type with removable shoes. Of the two roads who do not recommend alligator crossheads, one recommends guides of a special box construction, located wholly above the piston rod, and a one-piece crosshead with multiple-bearing flanges to provide maximum bearing areas for the resistance of upward and downward thrusts. The other road uses the Laird type crosshead exclusively. Both roads have had unsatisfactory experience with crossheads and guides of the alligator type. A few roads recommending the alligator crossheads and guides also recommend crossheads of the multiple bearing or Laird crosshead types.

The principal advantages claimed for the alligator type of crosshead are:

Simplicity of construction.
Freedom from unbalanced inertia forces.
Equal bearing pressures and fiber stresses in both forward and backward motion.

The disadvantages mentioned in connection with the alligator crosshead are:

Relatively heavy weight.
Interference with application and removal of front side rods.
Bearing surfaces exposed to dirt, and lubrication difficulties.

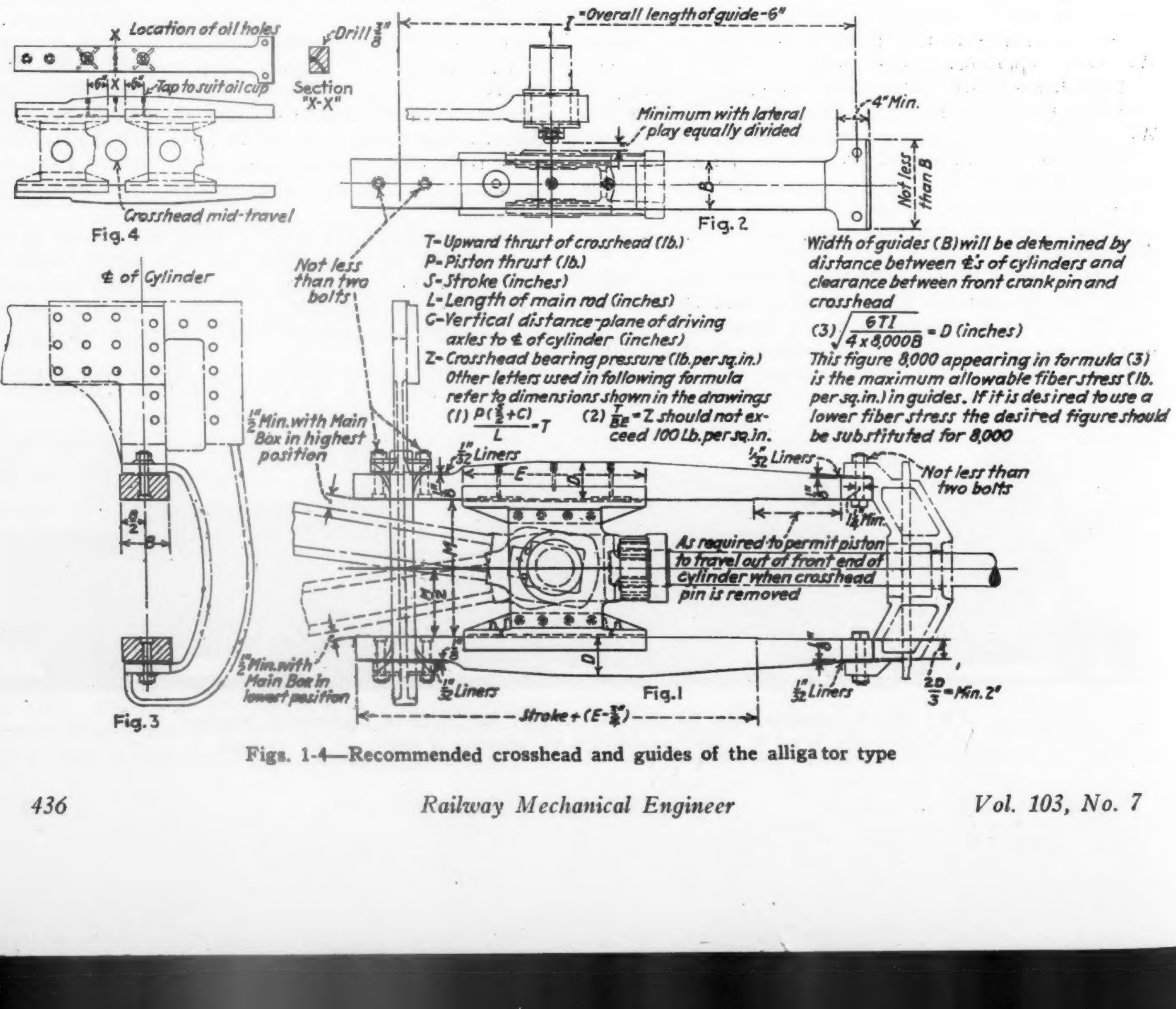
The advantages claimed for the multiple-bearing and Laird type of crossheads are:

Light weight.
Better protection against road dust.
Less lubrication difficulty.
Freedom from interference with front side rods.

The principal disadvantage inherent in both these types is the unbalanced inertia forces.

In view of the preponderance of opinion in favor of the alligator type, the committee is presenting, in Figs 1 to 9, inclusive, crossheads and guides of this design and recommend their adoption.

As a matter of interest and for information only the general design of the multiple-bearing crosshead is illustrated in Figs. 10 to 12 inclusive and the general design of a Laird crosshead by Fig. 13 to 16 inclusive.



Figs. 1-4—Recommended crosshead and guides of the alligator type

Cast steel is the material used by practically all roads and locomotive builders for crossheads, but one road has lately developed a forged steel crosshead in which the crosshead and piston rod are combined in a single piece.

Methods of Lubricating Crossheads and Guides

All parties reporting information to the committee follow the practice of lubricating the bearing surfaces of guides with oil. Many different kinds of oil-feeding devices are used for this purpose, most of them being manufactured articles that are sold by railway supply concerns. The committee has, therefore, not considered it advisable to deal with the design and construction of these devices. It is, however, interesting to note that force-feed lubrication of guides is being used on several roads, some of them using for this purpose valve oil that is pumped to the guides from the same mechanical lubricator which supplies oil to the valves and cylinders. Other roads apply a separate mechanical lubricator which pumps engine oil to the guides only.

At least two roads are experimenting with soft grease for guide lubrication, this grease being applied through Alemite fittings. One road reports using, for guide lubrication on an extremely heavy locomotive, an unusually heavy viscous oil, which is fed through cups on the guides. In view of the preponderance of opinion favoring ordiary engine oil fed through guide cups, the committee recommends continuation of this practice pending further development of the various new lubricating systems now under development.

Taking Up Wear

A majority of the roads recommending crossheads and guides of the alligator and Laird types follow the practice of relining or renewing crosshead shoes when it becomes necessary to take up wear in the course of running repairs. A few roads, however, use for this purpose special mechanical devices which expand the crosshead shoes. Practically all roads apply shims between the guides and the supporting lugs on cylinder heads and guide yokes, the total thickness of these shims being adjusted during shop repairs to compensate for material worn or machined off of the guides, thus maintaining the standard distance between guides.

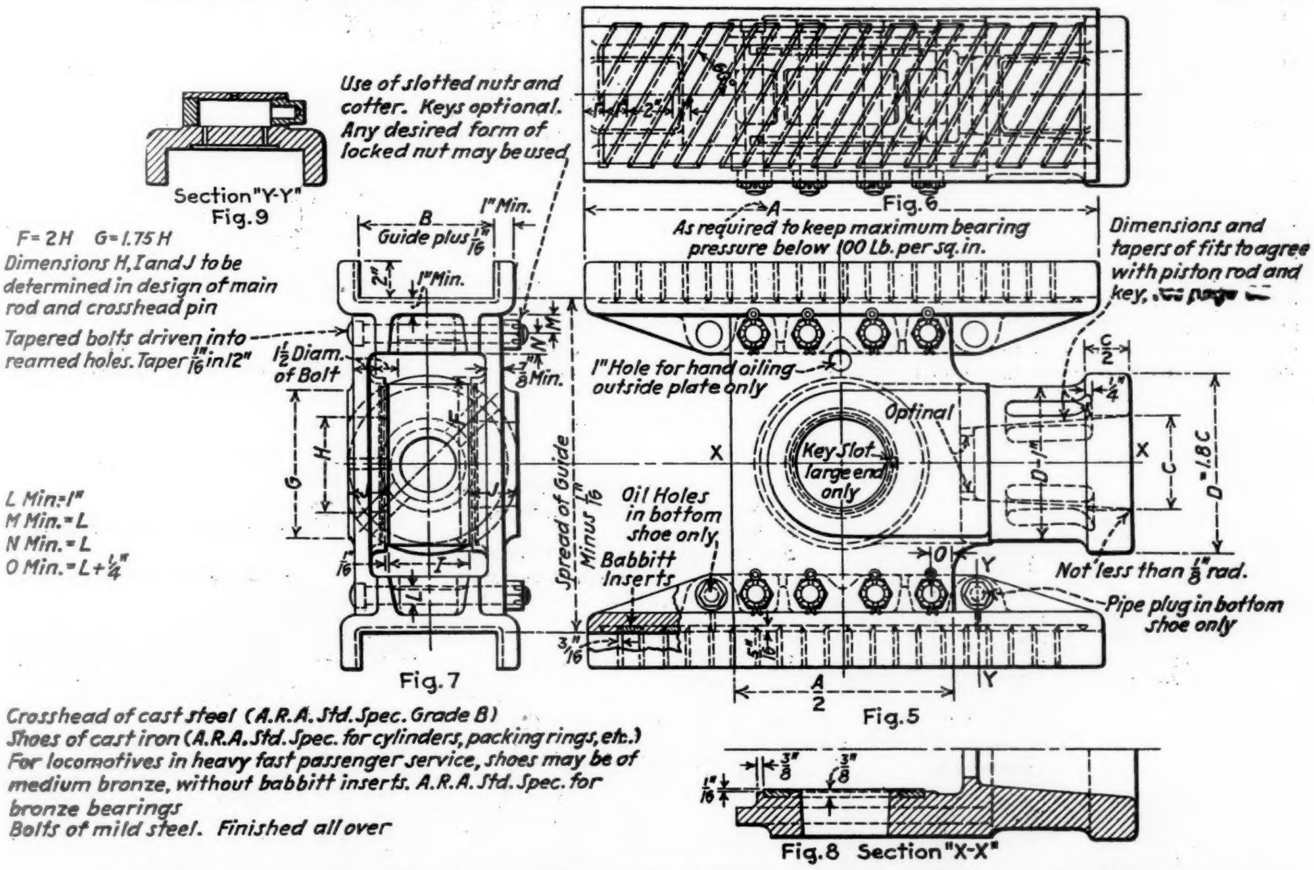
Practically all roads have, at one time or another, experienced trouble on account of main rods galling in the crossheads. The committee has endeavored to develop information with regard to the means employed to prevent this action. The result of the investigation is that several roads do not take any special precaution to prevent this action. One road claims they have no trouble. At least three follow the practice of tapering the end of the main rod. Several make the front-end main rod brass project slightly beyond the sides of the main rod, with the expectation of preventing the steel main rod from coming in contact with the sides of the crosshead. One road applies a bronze plate to each side of the main rod, these plates being held in place by means of countersunk-head screws. Three roads follow the practice of applying bronze rings to the inside faces of the crosshead. The committee feels that some means of preventing galling between sides of main rods and crossheads is of great importance and recommends the use of bronze rings, as shown in Figs. 5 to 8, inclusive.

Cylinder Heads

Figs. 17 to 19, inclusive, represent the practice recommended for the design of front and back cylinder heads for locomotive cylinders up to 32 in. in diameter and for boiler pressures up to, and including, 300 lb. per sq. in. The design recommended reflects the practices followed by a majority of the roads and locomotive builders. Attention is called to the fact that the guide supporting lugs of the back cylinder heads are shown above the top guide and below the bottom guide. It is felt that this is preferable to the somewhat prevalent practice of placing these supporting lugs inside of the guide bars, as it relieves the guide bolts of all tensile stresses.

The committee was instructed to ascertain to what, if any, extent guides have been, or are being applied to locomotives without being attached to the back cylinder heads. No railroads or locomotive builders follow this practice.

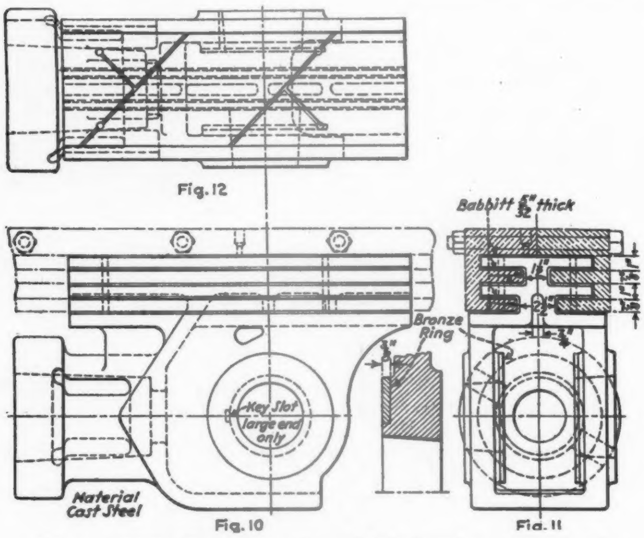
The committee was also requested to ascertain what means are being employed, in connection with guide fastenings, to



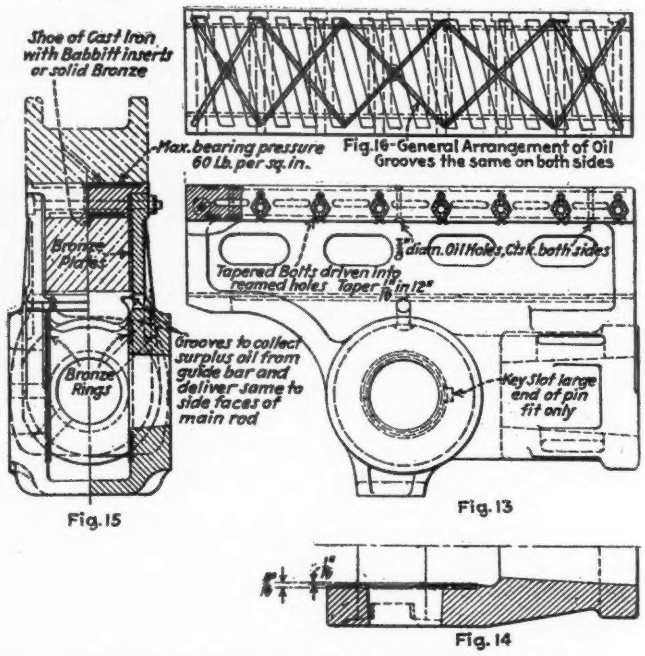
Figs. 5-9—Recommended design of alligator type crosshead with bronze rings on inside faces

compensate for the heat expansion of guides and cylinders, particularly when the guides are attached to the back cylinder heads. Only two roads report the application of devices for this purpose; all others reporting on this feature state that such provision is not necessary.

Figs. 20 to 22, inclusive, present the recommendations of the committee with regard to the design of crosshead or wrist pins. Approximately half the parties reporting find it possible to apply all crosshead pins from the inside of the crosshead, and recommend securing the pins in place with nuts applied to the outside end. Several roads find it necessary to apply the crosshead pin from the outside of the crosshead, and a number of different devices for holding such pins in place were recommended. Several of these devices appear to be patented. The committee, however, has failed to find any device for fastening outside inserted crosshead pins that has proven to be entirely satisfactory, and is as yet unable to offer any recommendations regarding crosshead pins inserted from the outside. Several roads recommend the use of tapered keys, instead of nuts, for the purpose of holding crosshead pins in position. This type of crosshead pin fastening appears to be gaining favor, and it has been included in the drawings for the benefit of such roads as care to make use of it.

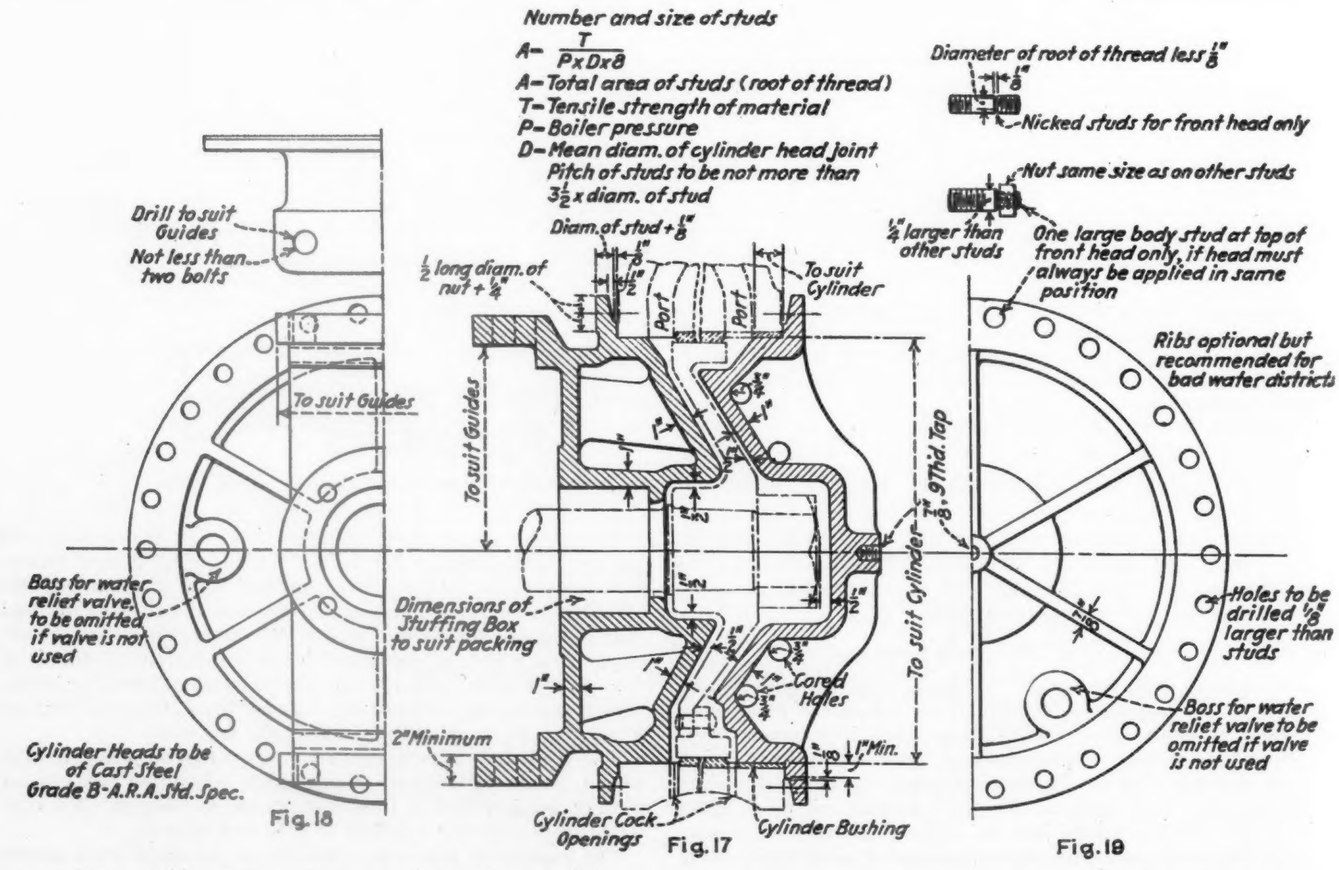


Figs. 10-12—Example of multiple-bearing crosshead



Figs. 13-16—Example of Laird type crosshead

Nearly all parties recommend the use of grease for crosshead pin lubrication. A number of different devices for this purpose were recommended. The committee, however, selected



Figs. 17-19—Recommended front and back cylinder heads up to 32 in. in diameter and 300 lb. steam pressure

one which appears to have the widest application and has been in use for a number of years on the U. S. R. A. standard locomotives built during the late war. The key type of crosshead pin fastening introduces some difficulties in connection with grease lubrication of crosshead pins. Oil lubrication is therefore used in most cases where this type of fastening is employed, the oil being applied as shown in Fig. 21. One road recommends the use of a grease cup cast integral with the crosshead, which appears to possess considerable advantage for use in connection with any type of crosshead pin fastening, but would be particularly advantageous in connection with the key type of fastening. This grease cup is shown in connection with the key fastening in Fig. 22.

Knuckle Joints for Side Rods

Figs. 23 to 28, inclusive, represent the recommendations of the committee regarding the design of the knuckle joints for locomotive side rods. The drawings are practically self-explanatory, and we are in line with the practice of checking the strength of locomotive side roads as described in the Manual.

The report of the sub-committee is signed by H. H. Lanning, (chairman), J. C. Hassett, S. S. Riegel and W. I. Cantley.

Exhibit "B"—Feedwater Heaters and Exhaust Steam Injectors

The continued increase in the number of applications of feedwater heating devices indicates that they have become an essential part of the super-power locomotive, and that they are being applied in considerable numbers to the more modern locomotives of lesser power. The following tabulation shows the number of Exhaust Steam Feedwater Heaters and Exhaust Steam Injectors installed on locomotives in United States and Canada, or on order, up to January 1, 1929:

Feedwater Heaters

Year	Mfr. "A" Closed Type	Mfr. "B" Open Type	Mfr. "C" Closed Type	Total Feedwater Heaters
(Prior to 1920)		4		4
1920	17	33		50
1921	40	64		104
1922	319	105		424
1923	242	730		972
1924	432	292		724
1925	357	307		664
1926	565	339	3	907
1927	456	461	68	985
1928	449	362	209	1,020
Total	2,877	2,697	280	5,854

Exhaust Steam Injectors

Year	Mfr. "D"	Mfr. "E"	Total Exhaust Steam Injectors
(Prior to 1920)			
1920			
1921			
1922	6		6
1923	14		14
1924	4		4
1925	74	3	77
1926	225		225
1927	53		53
1928	46	37	83
Total	422	254	676

Note: Above data furnished by manufacturers.

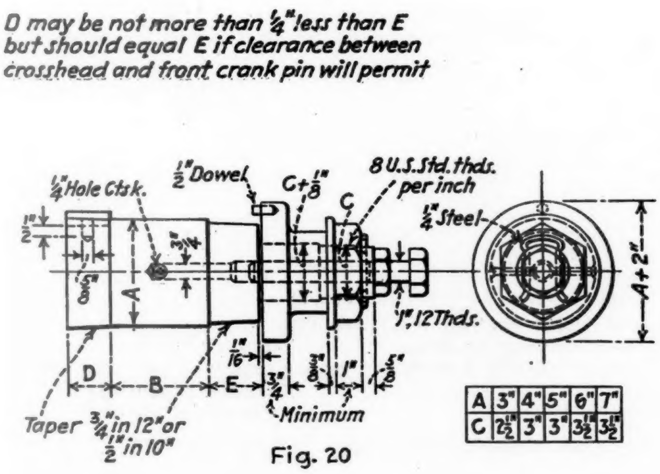
Exhaust Steam Injectors—It will be noted from the above table that the applications of exhaust steam injectors have not kept pace with those of feedwater heaters. Your committee believes that one of the principal reasons for the decline in the applications of exhaust steam injectors in this country has been the more complicated manual operation of these devices as compared with feedwater heaters and ordinary injectors. The manufacturers of these devices have recognized this and are endeavoring to modify them so that they can be operated as simply as an ordinary injector and are making other changes designed to reduce maintenance and increase efficiency.

Feedwater Heaters—Closed Type—At present there are two manufacturers of closed heaters in this country, a new type having been introduced in 1926. With this heater curved tubes are used to take care of expansion without using floating headers. The heater unit is mounted on the front of the smokebox and conforms to its contour. The pump used is of the horizontal single stage turbo-centrifugal type.

The other manufacturer uses a straight tube heater, with floating headers. The heater is placed either over the smokebox or just ahead of the cylinders. The pumps furnished are of the positive displacement type; those for the larger sizes having two cylinders, which give a more continuous flow. They have also been developing a turbine driven unit. A vertical centrifugal pump was first tried, but was followed by a horizontal unit, a number of which were placed in operation during the latter part of 1928.

Improvements have been made on the closed heaters from time to time with a view to reducing maintenance and increasing efficiency.

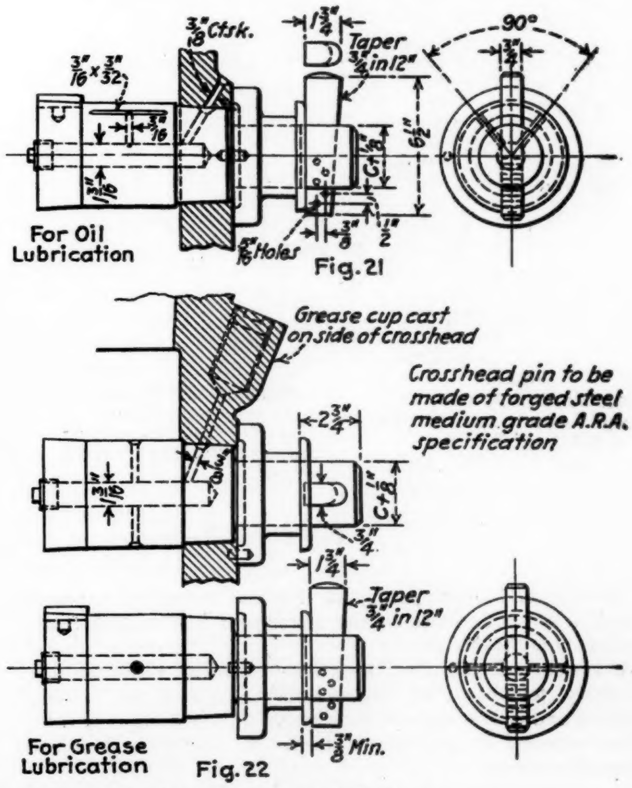
Feedwater Heaters—Open Type—The manufacturer of open heaters has continued the standard single unit using displace-



Crosshead Pin Bearing Pressure

$\frac{\text{Piston Thrust}}{A \times B}$ = Bearing Pressure (should not exceed 4,800 Lb.)

$\frac{\text{Piston Thrust}}{A \times (D+E)}$ (Should not exceed 5,000 Lb.)



Figs. 20-22—Recommended crosshead wrist pins with oil and grease lubrication

ment pumps, incorporating, from time to time, improvements which experience with these pumps has shown to be desirable. Difficulties with check valves have been overcome by using a larger size boiler check than was standard practice with injectors, spring loading this valve, and reducing its lift.

This company has recently developed a new heater in which the elements are divided to facilitate applications to larger power, and to secure a better weight distribution. With this equipment the cold water pump is located under the cab; the heater itself is in the smokebox, and the hot water pump is located either on the side or front of the engine, and exhausts directly into the heater. The cold water pump is a constant-speed turbo-centrifugal unit, furnishing water in an amount determined by the regulator valve in the heater. The hot water pump of the horizontal piston type, equipped with a valve, automatically controlled by exhaust pressure, that reduces the speed of the pump when drifting to a predetermined rate that is sufficiently low to prevent damage to boiler from cold water.

Operation of Pumps on Superheated Steam—With the introduction of the front-end throttle, a number of roads are operating most of their auxiliaries, including the feed pump, on superheated steam.

Economies of Feedwater Heaters and Exhaust Steam Injectors—The saving accruing from feedwater heating is dependent upon many factors, such as capacity of locomotive boilers, topography, operating conditions, outdoor temperature and cost of fuel.

There are incidental savings due to the use of feedwater heaters and exhaust steam injectors that undoubtedly exist, but are difficult to estimate: an increase in the power of the locomotive at higher speeds, an increase in equivalent tender capacity, and a decrease in the amount of incrustating matter carried into the boiler.

A system of periodic inspection, including cleaning when necessary, together with proper running repairs and thorough cleaning and overhauling at back shoppings, is absolutely essential to successful operation of feedwater heaters and exhaust steam injectors.

The report of the subcommittee is signed by Geo. McCormick, (chairman), H. M. Warden, A. H. Fetters and M. F. Cox.

Exhibit "C"—Back Pressure and Initial Pressure Gages

The 1928 report listed various types of initial and back pressure gages and cut-off control devices and recommended that roads select the types most likely to meet their service requirements and try them out so as to aid in their development as they gave considerable promise of effecting more economical locomotive operation.

To show the trend of interest in this direction the committee has secured from the principal manufacturers, statements showing the number of each kind or style supplied the roads during the years 1923 to 1928 inclusive. This information is shown in the following table:

Year	1923	1924	1925	1926	1927	1928	Total
Initial and Back Pressure Gages	—	—	918	1508	2181	1793	6400
Locomotive Valve Pilots	—	—	—	—	5	54	59
Locomotive Back Pressure Cut-Off Controls	32	26	17	8	7	2	92

Reduction of Back Pressure—The energy developed in the cylinders of a locomotive is a function of the mean effective pressure, speed, area of piston and length of stroke. The area of piston and length of stroke are constant for a particular locomotive, whereas the mean effective pressure and speed are variables. The mean effective pressure depends upon the sequence of valve events, boiler pressure, back pressure, etc. In the operation of a locomotive with a well designed valve motion, the one item that is under control of the engineer that materially affects the mean effective pressure and economical use of steam is the cut-off. The back pressure depends upon the cut-off, speed and the size of the exhaust nozzle tip. At a fixed speed, with a given size of nozzle tip the back pressure will decrease as the cut-off is shortened; but not in direct proportion. Back pressure can be looked upon as negative work done by the pistons in producing draft and disposing of the steam used in producing useful work.

As an example from actual test, a mikado locomotive having 28 in. by 30 in. cylinders, with 63 in. drivers, and carrying 180 lb. boiler pressure, when working hard on a 0.4 per cent grade, will with 53 per cent cut-off develop a mean effective pressure of 100 lb. per sq. in. at 21 m.p.h., 2086 i. hp., and the back pressure will be about 12 lb. per sq. in. If the cut-off were lengthened due to improper operation on the part of the engineman, so as to increase the back pressure to 17 lb. per sq. in.,

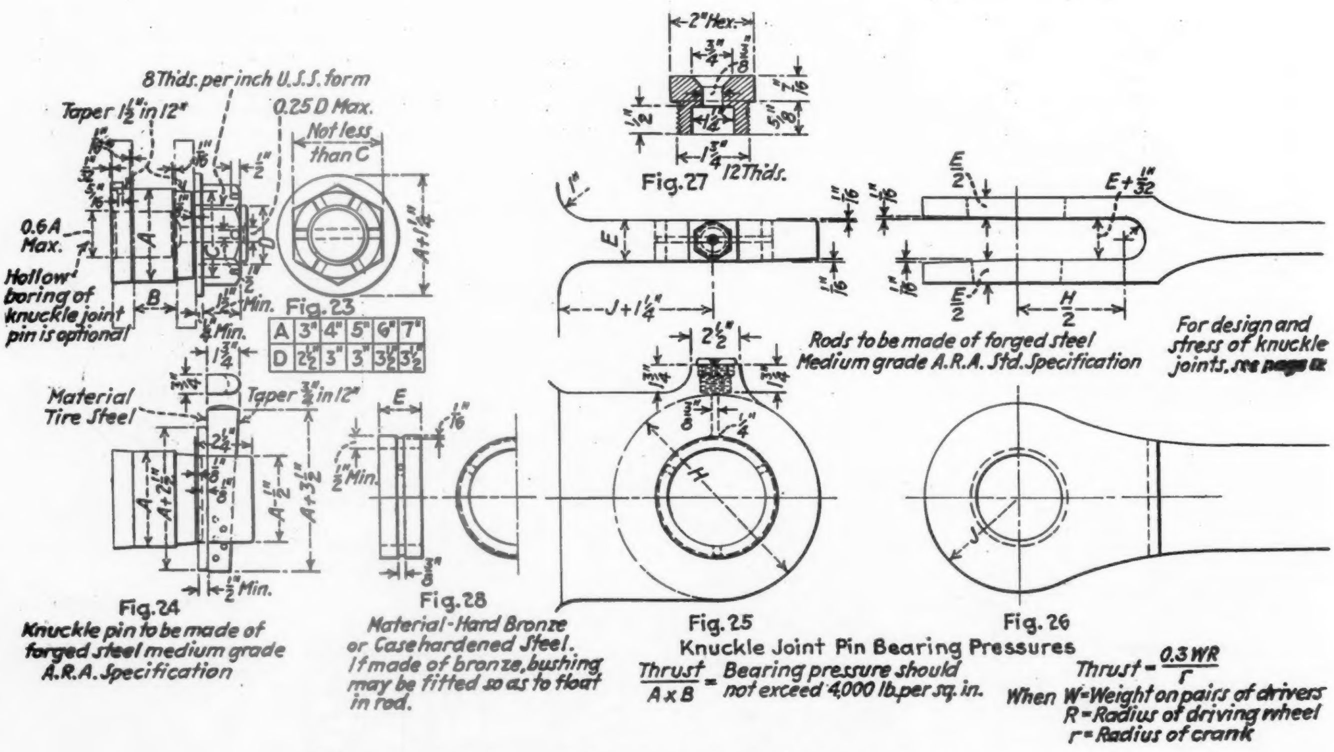


Fig. 23-28—Recommended designs of knuckle joints for side rods

the steam would not be used quite as expansively, and this together with the increase in back pressure would increase the steam and fuel consumption about 5 per cent. Such a locomotive working on a division of 151 miles, containing 26 miles of continuous 0.2 per cent grade, 78 miles of continuous 0.4 per cent grade and 47 miles of descending grade, will operate over the division under favorable conditions with an average back pressure when working steam of about 12 lb. and consume per trip about 24 tons of sub-bituminous coal costing $3.00 per ton. With an increase in back pressure of 5 lb. the fuel consumption per trip would be increased about 5 per cent or 1.20 tons, which at $3.00 per ton amounts to $3.60 per trip. On the return trip where descending grades prevail, the savings would, of course, be less.

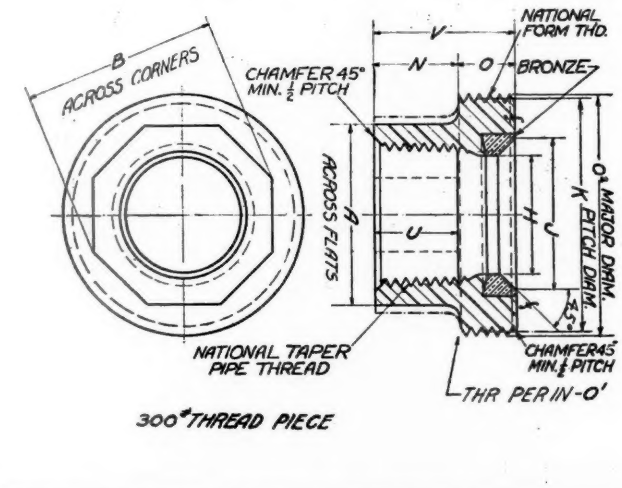
This same locomotive operating on a division having an undulating profile with grades of from 0.1 to 1.0 per cent with 0.1 per cent predominating, will consume about 23 tons of Eastern coal in a run of 200 miles with a tonnage train. The value of this coal at $4.00 per ton is $92.00, and if the locomotive were operated so that the average back pressure would be increased 5 lb., the additional fuel consumed would cost $4.60 per trip.

These examples serve to illustrate the economic advantages of operating with the minimum cut-off and back pressure possible under the prevailing operating conditions.

Initial and back pressure gages properly installed and maintained may be expected to produce the following results:

Initial Pressure Hand: 1. Indicates to the engineman the pressure in the steam chest at all times and enables him to know when the throttle is open sufficiently to establish maximum steam chest pressure.

2. Enables the engineman to control properly the correct amount of steam to the cylinders while drifting.



300# THREAD PIECE

SIZE	A	B	H	J	K	N	O	V	U	O'	O²
¼"	.75	.79	.38	.58	1.050"/1.047"	.49	.35	.84	.43	16-N	1.090"/1.081"
⅜"	.90	.95	.54	.75	1.230"/1.227"	.55	.39	.94	.47	14-N	1.276"/1.266"
½"	1.09	1.15	.68	.93	1.440"/1.437"	.60	.39	.99	.57	14-N	1.486"/1.476"
¾"	1.35	1.43	.85	1.07	1.770"/1.766"	.68	.50	1.18	.64	11-N	1.829"/1.817"
1"	1.63	1.74	1.10	1.36	2.100"/2.096"	.76	.50	1.26	.75	11-N	2.159"/2.147"
1¼"	2.00	2.14	1.40	1.64	2.530"/2.526"	.88	.55	1.43	.84	10-N	2.598"/2.588"
1½"	2.27	2.43	1.63	1.92	2.850"/2.846"	.97	.55	1.52	.87	10-N	2.915"/2.902"
2"	2.80	3.00	2.06	2.36	3.450"/3.446"	1.12	.55	1.67	1.00	10-N	3.518"/3.505"
2½"	3.37	3.61	2.54	2.89	4.140"/4.135"	1.30	.75	2.05	1.17	8-N	4.221"/4.206"
3"	4.05	4.35	3.05	3.51	4.920"/4.915"	1.40	.75	2.15	1.23	8-N	5.001"/4.986"

Proposed standard union thread pieces

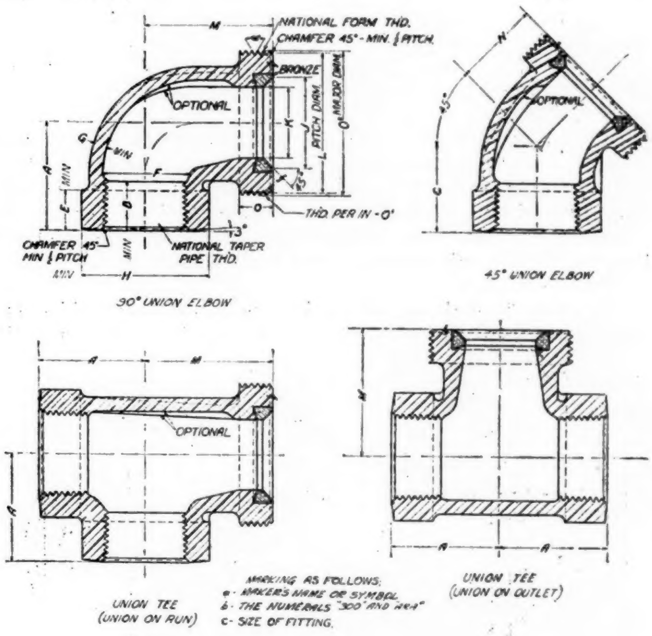
Back Pressure Hand: 1. Enables the engineman to regulate the cut-off for minimum back pressure consistent with the operating conditions; and independently of any definite location of the reverse lever with respect to the quadrant.

2. Assists those directly concerned with locomotive performance to determine when a locomotive is equipped with the wrong nozzle or if changes have been made in the drafting arrangement.

3. Assists the engineman in detecting and locating any marked irregularities in the valve setting and steam distribution.

4. Enables the engineman to visualize the wasteful effect produced by dropping the reverse lever below the correct working point as shown by the back pressure hand.

5. Demonstrates to the engineman the harmful effects of carrying high water, indicated by a quick rise of the back pressure, which is due to the sudden reduction in the temperature of the superheated steam, with material loss in fuel economy.



UNION FITTINGS — FOR MAX. WORKING PRESSURE OF 300# STEAM.																			
SIZE	A	B	C	E	F MIN.	F MAX.	G	H	J	K	L	M	N	O	O'	O²	O³	NOTE #1 E
¼"	.94	.43	.81	.38	.540	.584	.14	.93	.58	.38	1.05	1.16	.78	.35	16-N	.0541	.0625	.04
⅜"	1.06	.47	.88	.44	.675	.719	.15	1.12	.75	.54	1.23	1.34	.86	.39	14-N	.0618	.0714	.05
½"	1.25	.57	1.00	.50	.840	.897	.16	1.34	.93	.68	1.44	1.46	.99	.39	14-N	.0618	.0714	.06
¾"	1.44	.64	1.13	.56	1.050	1.107	.18	1.63	1.07	.85	1.77	1.81	1.12	.50	11-N	.0787	.0909	.06
1"	1.63	.75	1.31	.62	1.315	1.385	.20	1.95	1.36	1.10	2.10	1.97	1.30	.50	11-N	.0787	.0909	.07
1¼"	1.94	.84	1.50	.69	1.660	1.730	.22	2.39	1.64	1.40	2.53	2.29	1.49	.55	10-N	.0866	.1000	.07
1½"	2.13	.87	1.69	.75	1.900	1.970	.24	2.68	1.92	1.63	2.85	2.44	1.66	.55	10-N	.0866	.1000	.08
2"	2.50	1.00	2.00	.84	2.375	2.445	.26	3.28	2.36	2.06	3.45	2.74	1.93	.55	10-N	.0866	.1000	.08
2½"	2.94	1.17	2.25	.94	2.875	2.975	.31	3.86	2.89	2.54	4.14	3.43	2.19	.75	8-N	.108	.1250	.10
3"	3.38	1.23	2.50	1.00	3.500	3.600	.35	4.62	3.51	3.05	4.92	3.81	2.62	.75	8-N	.108	.1250	.10

Proposed standard union elbows and tees

6. Assists the engineman to detect a creeping reverse gear which shows up at the back pressure hand by a creeping movement of the hand either upward or downward.

Due to the limited number of Locomotive Valve Pilots and Automatic Back Pressure Cut-Off Control devices in service at the present time the committee does not have available sufficient information to enable it to make any definite report as to the efficiency or merits of these devices.

The report of the subcommittee is signed by S. Zwight, (chairman), Geo. McCormick, E. C. Anderson, and R. M. Brown.

Exhibit "D"—Standardization of Pipe Unions of Nut and Nipple Type

In July, 1927, the late A. Kearney, superintendent of motive power, Norfolk & Western, formerly a member of this committee, recommended that the association consider the adoption of standard pipe unions of the nut and nipple type. Mr. Kearney had in mind a standard union for all classes of work on freight and passenger cars as well as locomotives, and that the standard adopted should cover the flat joint union using a gasket, as well as ball joint union without gasket.

The subject was referred to this committee with request that recommendations be prepared for standard pipe unions of nut and nipple type for locomotives, which would then be referred to the Car Construction Committee for its approval, after which, if approved by the General Committee, to be submitted to

the Division of Simplified Practices, Department of Commerce.

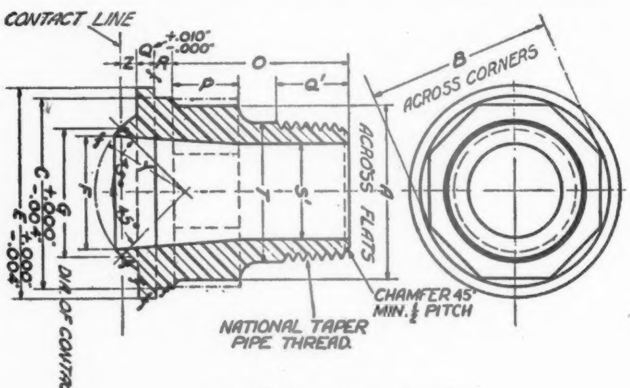
Your committee has considered only the ball joint type of union for the reason that this type is most generally used and the gasket type is fast becoming obsolete for locomotives. It is further recommended that the ball joint type be given consideration for use upon rolling stock equipment.

In 1903 the association adopted a standard pipe union of the gasket type, revised in 1916; the revision covering the branding of the unions with the letters "A. R. M. M. A." It is the understanding of the committee that this design of union has never been generally used and if the designs now proposed are adopted, they will displace the old design now shown in the manual.

New designs include ordinary unions, union ells, and union tees, all of which have been quite extensively used in locomotive piping for several years.

The designs proposed and the strength of the unions are proportionate to the sectional areas of extra-strong pipe at the root of the thread at "E" dimension of the American Standard Pipe Thread, A. S. T. M. Specification 2357 for Bessemer welded steel pipe. Fifty thousand (50,000) pounds per square inch tensile strength represents the basis for the design of the union.

The strength of the collar on the nipple and the shoulder on the nut are made liberal to prevent the nut from being pulled



300# MALE TAIL PIECE

SIZE	A	B	C	E	F	G	Q	R	O	Z	Y	Q'	P	S'	T
¼"	.75	.79	.83	.965	.38	.48	.125	.125	1.11	11	34	.401	.38	.26	54
⅜"	.90	.95	.99	1.135	.54	.645	.135	135	1.22	.11	45	.407	.44	.36	675
½"	1.09	1.15	1.19	1.345	.68	.805	.145	.145	1.35	11	56	533	.50	.49	84
¾"	1.35	1.43	1.47	1.65	.85	.96	.16	.16	1.53	.12	68	.545	.56	.67	1.05
1"	1.63	1.74	1.78	1.975	1.10	1.23	.18	.175	1.67	.13	87	.682	.62	.88	1.315
1¼"	2.00	2.14	2.18	2.395	1.40	1.52	.21	.205	1.83	.13	1 07	.706	.69	1.16	1.66
1½"	2.27	2.43	2.47	2.71	1.63	1.775	.23	.22	1.91	.14	1.25	.723	.75	1.35	1.90
2"	2.80	3.00	3.04	3.31	2.06	2.21	.26	.25	2.04	.17	1.56	.756	.84	1.75	2.375
2½"	3.37	3.61	3.66	3.97	2.54	2.715	.295	.28	2.30	.19	1.92	1.137	.94	2.16	2.875
3"	4.05	4.35	4.40	4.745	3.05	3.28	.325	.315	2.63	.21	2.31	1.200	1.00	2.67	3.50

Proposed standard union tail pieces with external threads

over the collar and the strength of both is based on the strength of the pipe—all other dimensions are made as small and light as possible, as clearances, tolerances and strength of the parts would permit.

Dimensions are for malleable iron and for interchangeability of the separate parts, same dimensions would apply for unions made of steel.

The proposed design of union is capable of withstanding pressures up to 300 lb. and is, therefore, designated as a 300-lb. union. While it is true that many pipes, such as those in the air brake system carry pressures much lower, it was concluded that since extra-heavy pipe is generally used on locomotive equipment to withstand vibration, that the strength of the union ought to be equal to the strength of the pipe.

Drawings showing the dimensions tolerances and formula used in design of unions are submitted as part of this report.

A proposed specification is also submitted for consideration by the Committee on Specifications and Tests for Materials.

1. *Scope.*—This specification covers malleable iron and steel pipe unions and combination union fittings for use on locomotives under working pressures up to 300 lb. per sq. in.

I. Manufacture

2. *Process.*—Malleable iron shall be made in accordance with the best commercial practice with respect to composition, melting and annealing. Steel shall be made by the open hearth or electric process. All castings shall be thoroughly annealed. Rolled steel to be used in forgings or manufacture by machining, shall be sound and free from segregation. Nonferrous inserts shall be made of sound, tough brass or bronze. All inserts shall be securely attached to their supporting members.

Galvanized unions shall be thoroughly and smoothly coated with zinc by the hot dipping process.

3. *Proof Test.*—Each individual union shall be tested by the manufacturer, under water or oil, with air at 150-lb. pressure. No copper or rusting solution, cement or welding will be permitted.

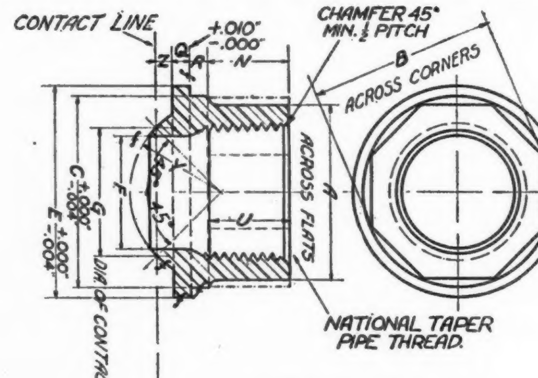
II. Properties and Tests

4. *Finished Unions.*—The weights and strengths of unions shall not be less than those shown in Table I.

TABLE I.

Pipe Size in.	Minimum weight of Union	Tensile Strength Tightening moment (ft. lb.)	Load at Leaking
⅛"		55	1600
¼"		85	2600
⅜"	(to be	130	3900
½"	added	180	5400
¾"	after	250	7600
1"	samples	360	11000
1¼"	have	530	16000
1½"	been	670	20000
2"	made)	970	29000
2½"		1400	41500
3"		1950	58500

5. *Method of Test.*—In testing the strength of unions, a solid iron or steel bar shall be screwed into one end, and into the other, a piece of heavy walled tubing or a bored bar which shall be connected to a water supply having a pressure of 40 lb. per sq. in. The union nut shall be tightened with a static turning moment of the intensity shown in the table. The air in the hollow bar shall be suitably vented before beginning



300# TAIL PIECE

SIZE	A	B	C	E	F	G	Q	R	N	Z	Y	U
¼"	75	79	.83	.965	.38	48	.125	.125	.49	1.1	.34	.43
⅜"	.90	95	.99	1.135	.54	645	.135	.135	55	11	.45	.47
½"	1.09	1.15	1.19	1.345	68	805	.145	.145	.60	.11	.56	.57
¾"	1.35	1.43	1.47	1.65	.85	.96	.16	.16	.68	.12	.68	.64
1"	1.63	1.74	1.78	1.975	1.10	1.23	.18	.175	.76	.13	.87	.75
1¼"	2.00	2.14	2.18	2.395	1.40	1.52	.21	.205	88	.13	1.07	.84
1½"	2.27	2.43	2.47	2.71	1.63	1.775	.23	.22	.97	.14	1.25	.87
2"	2.80	3.00	3.04	3.31	2.06	2.21	.26	.25	1.12	.17	1.56	1.00
2½"	3.37	3.61	3.66	3.97	2.54	2.715	.295	.28	1.30	.19	1.92	1.17
3"	4.05	4.35	4.40	4.745	3.05	3.28	.325	.315	1.40	21	2.31	1.23

Proposed standard union tail pieces with internal threads

the test. The assembly shall then be pulled in tension at a crosshead speed of one-half to one inch per minute. The load shall be noted at which the first leak occurs.

If the union leaks before reaching the specified minimum load, the union nut will be tightened as before, and the test repeated, once.

6. *Number of Tests.*—Three unions or union fittings of each size will be tested for each 1000, or less, of each size in each shipment, and one additional for each additional 1000. If any fail to meet the required minimum load, two more will be tested for each one which fails. Both of these shall meet the requirements.

III. Workmanship and Finish

7. *Dimensions.*—Union shall conform to the limiting dimensions shown on drawings forming a part of this specification.

8. *Finish.*—Surfaces which are to remain in the cast condition shall be

reasonably smooth and free from scale, fins, lumps, cracks, cavities and other injurious defects. Machined surfaces shall be smooth and fit properly against the adjoining parts. All parts shall be finished and assembled in a workmanlike manner. All unions shall be well oiled, to prevent rust in transit or storage.

IV. MARKING

9. *Marking.*—Unions shall bear maker's name or symbol, the size, the designation 300-lb., and "A. R. A." clearly cast or stamped into the metal.

V. INSPECTION AND REJECTION

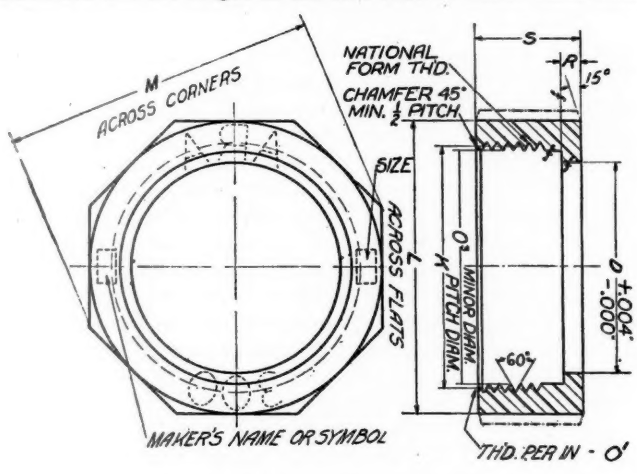
10. *Inspection.*—Unless otherwise specified by the purchaser, the inspection of unions shall be made at the place of manufacture. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

11. *Rejection.*—Unions which do not fill the requirements of these specifications will be rejected. Unions, which, subsequent to above tests at the works or elsewhere and their acceptance, show any defects shall be rejected and shall be replaced at the expense of the manufacturer.

The report of the subcommittee is signed by R. M. Brown (chairman), W. I. Cantley and S. S. Riegel.

Exhibit "E"—Tender Tank Hose

To develop an answer to an inquiry from the Specification Committee for proposed standardization of the outside diameters and the length of the soft ends of tender tank hose,



300# UNION RING

SIZE	K	L	M	R	S	D	O'	O³
¼"	1.052"/1.055"	1.35	1.45	.125	.65	.86	16N	1.030"/1.025"
⅜"	1.232"/1.235"	1.55	1.67	.135	.71	1.02	14N	1.207"/1.199"
½"	1.442"/1.445"	1.78	1.92	.145	.73	1.22	14N	1.417"/1.409"
¾"	1.772"/1.776"	2.18	2.35	.16	.88	1.51	11N	1.740"/1.730"
1"	2.102"/2.106"	2.55	2.73	.175	.925	1.82	11N	2.070"/2.060"
1¼"	2.532"/2.536"	3.04	3.28	.205	1.035	2.22	10N	2.497"/2.486"
1½"	2.852"/2.856"	3.39	3.66	.22	1.07	2.52	10N	2.817"/2.806"
2"	3.452"/3.456"	4.05	4.37	.25	1.15	3.09	10N	3.417"/3.406"
2½"	4.142"/4.147"	4.83	5.21	.28	1.425	3.72	8-N	4.099"/4.086"
3"	4.922"/4.927"	5.69	6.14	.315	1.49	4.46	8-N	4.879"/4.866"

Proposed standard union ring pieces

a tentative design was prepared and submitted to the manufacturers of tender tank hose. Based on answers received and a study of the subject, the following paragraph is proposed for addition to Specifications of Tender Tank Hose. After No. 17 insert the following and renumber the paragraphs.

III. Standard Sizes and Dimensions

18. Outside diameter and length of soft ends: Outside diameter and length of soft ends of hose shall conform to the following table:

Nominal Inside Diameter Inches	Outside Diameter, Soft Ends. Maximum Inches	Outside Diameter, Soft Ends. Minimum Inches	Length Soft-Ends Inches
2¼	3⅛	3	3
2½	3⅜	3¼	3
3	3⅞	3¾	3
3½	4⅜	4¼	3
4	4⅞	4¾	3
4½	5⅜	5¼	3

The report of the subcommittee is signed by H. A. Hoke, (chairman), L. A. Richardson, E. C. Anderson and J. C. Hassett.

Exhibit "F"—Springs and Repairs to Springs

[A subcommittee appointed to make report and study on repairs and manufacture of springs and also consider specifications for spring steel bar stock submitted a full and well illustrated report which will appear in the August issue of the *Railway Mechanical Engineer.*—EDITOR.]

The report of the subcommittee is signed by George H. Emerson (chairman), C. E. Brooks, H. A. Hoke and A. H. Fetters.

Exhibit "G"—Formula for Computing Tractive Effort of Locomotive Booster

All data furnished by the principal booster manufacturers has been carefully reviewed. Manufacturers have submitted what they term "specific data" covering mean effective pressures corresponding to different cut-offs, together with data on gear ratios, etc. However, it is the thought of your subcommittee that booster tractive effort should be expressed by an empirical formula, precisely similar in form and application to the usual tractive force formula universally used for locomotives, particularly in view of the fact that the proposed formula will be required principally for statistical purposes, and we respectfully submit such a formula, although we realize that the results obtained will not agree with the manufacturers' rating of different boosters, particularly in view of the fact that their figures represent drawbar pull at various speeds, and not starting tractive effort. If, on the other hand, anyone desires to construct a drawbar-pull formula for test purposes, they are at liberty to construct their own formula to suit their own specific requirements.

As the cylinder tractive effort of the locomotive is practically constant up to about 250-ft. per min. piston speed, upon which the standard formula is based for the nominal rating of cylinder tractive effort, we have expressed the value of the coefficient as .80, or 80 per cent of boiler pressure, and have also introduced the factor "r", which is the ratio between the number of teeth in the axle gear to the number of teeth in the crank shaft gear. The formula thus becomes:

$$T = \frac{.80\, P\, d^2\, S\, r}{D}$$

where T = Tractive effort of the Booster,
.80 = Ratio of mean effective pressure in cylinders to boiler pressure,
d = Diameter of cylinders in inches,
S = Stroke, in inches,
r = Gear ratio,
D = Diameter over tire of driven wheel,
P = Boiler pressure.

The report of the subcommittee is signed by A. H. Fetters (chairman), Geo. McCormick, R. M. Brown and W. I. Cantley.

The report of the Committee on Locomotive Design and Construction is signed by W. I. Cantley (chairman), mechanical engineer, Lehigh Valley; H. H. Lanning, (vice-chairman), mechanical engineer, Atchison, Topeka & Santa Fe; H. A. Hoke, assistant mechanical engineer, Pennsylvania; G. McCormick, general superintendent motive power, Southern Pacific; J. C. Hassett, mechanical engineer, New York, New Haven & Hartford; E. C. Anderson, mechanical engineer, Chicago, Burlington & Quincy; M. F. Cox, assistant superintendent machinery, Louisville & Nashville; C. E. Brooks, chief motive power, Canadian National; G. H. Emerson, chief motive power & equipment, Baltimore & Ohio; A. H. Fetters, general mechanical engineer, Union Pacific; S. Zwight, general mechanical superintendent, Northern Pacific; R. M. Brown, superintendent motive power, New York Central; H. M. Warden, mechanical superintendent, Missouri-Kansas-Texas; S. S. Riegel, mechanical engineer, Delaware, Lackawanna & Western and L. A. Richardson, general superintendent motive power, Chicago, Rock Island and Pacific.

Discussion

Mr. Demarest: I congratulate the committee on its report this year, because I feel that it is more practical than some previous ones we have heard. Not being one of the 21 railroads selected by the committee as representing the general practice of the country in connection with the type of guides and crossheads, perhaps I

may be permitted to say a few words. I think one of the reasons that the alligator type of crosshead has been so universally used is the ability to take up lost motion between the guides readily. The question of whether all stresses are exactly central is not quite material, because it simply means a construction which will meet those stresses, and in our own experience of the double-bearing guide, it has been very successful in its operation. It is more expensive but it has the decided advantage, brought out by the committee, that the bearing parts of the guide and crosshead are more protected against dust and wear.

I was surprised to see in the report that the outside entrance crosshead pin was not being used. The Pennsylvania, on all of its later engines, uses the crosshead pin which is on the outside, with a very simple retaining plate, on an engine of 250 lb. steam pressure. A larger number are grease lubricated and lubrication is very easily inserted from the outside.

In our engine house maintenance we have got to a position where our rod-brass work is one of the heaviest, if not the heaviest items, and anything that you have done in connection with the design which will give us more life of our rod brasses is bound to effect an immediate return.

I see no discussion of the solid front-end brass, and I assume that the committee has considered it but that it is not yet developed to a point where it can be discussed today. Some roads are using it, and I believe that some consideration should be given to it.

The report mentions the feedwater heater and the exhaust-steam injector. It is intimated that the manufacturers of exhaust-steam injectors have not yet sufficiently simplified the operation so that the ordinary engineman can handle it without difficulty.

The exhaust-steam injector is an English device and when it was first brought over there were more keys for its operation that there are keys on a piano, and that criticism was justified. Today, with the later developments, the manufacturers of exhaust-steam injectors have so simplified the device that there is practically no more difficulty in operating it than the ordinary lifting or non-lifting injector. You are going to get to the position eventually where you must decide between feedwater heaters or the exhaust-steam injector. My personal opinion is that the exhaust-steam injector in itself gives us everything that the other devices do, with less application costs, less maintenance costs, and every economy on your heavier power.

B. H. Gray (Gulf, Mobile & Northern): The road with which I am connected has applied two feedwater heaters. For a while when we watched them we thought we were saving some fuel, but when we put them in the pool you could not tell just what engines were equipped with the feedwater heaters unless you knew it beforehand.

Mr. Ripley: I will agree with Mr. Demarest that the feedwater heater is more expensive to maintain than the exhaust-steam injector and for that reason the exhaust injector should be developed further to see if it can't be made better. However, there are more problems in connection with this exhaust injector than have been mentioned. I have watched the operation of these machines on the English locomotives and their problem is totally different. The reason that they are so successful there is that their operation is very uniform; that is, there are not as many heavy grades; there are not as many stops; the fireman can set his injector and leave it alone. We have found on our own locomotives that the difficulties are to make constant adjustments in the exhaust injector, due to varying operating conditions. It is not a simple matter to teach the fireman the operation of these injectors, and perhaps we have not given the exhaust injector people a fair chance to demonstrate their possibilities. Ordinarily we put one of these devices on a locomotive or two, and the men do not become interested in them and do not thoroughly understand them. The only fair way to try them would be to put a large number of locomotives in operation with the same device so all of the men would become familiar with their operation. Then, I feel sure, you would get better results.

However, I want to call attention to the two conditions that are working against the exhaust steam injector. As you men all know, you are constantly working towards greater steam pressure. You are also constantly working to reduce back pressure. Each of these is detrimental to the exhaust-steam injector, and for that reason I feel that the problems are going to become harder instead of easier.

Mr. Demarest: It is easy enough to put any operation or put any detail of your locomotive on the drafting board but somebody in your engine house is responsible for the maintenance and operating costs of the device which you apply. I do not take the position that where an economic device is developed it should not be used, but it has got to pay its way. In the first place, the only return you get will be in fuel consumption. Your outgo is maintenance. The locomotive equipped with feedwater heaters take from two to three hours longer to turn than do the other locomotives. I know that we have got to have something, though, that will assist us in keeping the steam production closer to the demand we are making on it all the time. We have got to keep pace with all of the developments, but we have got to do it in a way that we are sure we are getting back more than we put into the operation. There is no use of trading dollars from one pocket to another.

Mr. Pownall: Considerable has been said about the maintenance of the feedwater heater, and I think we ought to make an effort to get this information in definite shape. I was on the sub-committee on this subject some time ago and I got the information from a number of roads that ran from $75 up to as high as $275 per heater per year. The road with which I am connected has kept this record for a number of years, and it ran around $200 per year. We kept the record of all labor and material and whatever the roundhouse repairs were. This is considerably less than the saving that you make in fuel if they do what is expected of them.

Sometimes you can't find the fuel saving in the fuel records. There are several reasons for that. When an engineman goes up to the coal chutes, if he has been in the habit of putting in a ticket for say five or six tons, if he has saved 10 per cent of the fuel, which is only a half ton, he does not see it and he puts in the same ticket. Furthermore, the feedwater-heater engine will move over the road faster and will produce more ton-miles per train hour. When you increase the speed of your train you will use more fuel and that often offsets the saving that you would have made if you had moved the train at the same speed. I examined the past performances of our heater locomotives. We have had engines that were apparently not showing a saving on the fuel reports, and I think we had about 7 per cent more ton-miles per train than did the best that the same class of engines that were not equipped with the heaters.

Mr. Chambers: I am in accord with the last speaker. It is and always has been a problem to find at the end of the month or at the end of the year just what improved devices have done. I have been guided largely by what enginemen say about these devices. It is a fact

that they expect, and get, more out of an engine with the feedwater heater or an exhaust injector than they do from one without it.

Chairman Smart: The sub-committee's report is now open for discussion.

A. H. Fetters (Union Pacific System): The road with which I am connected is perhaps one of the pioneers in the development of back-pressure gages. The real success to be obtained with this device lies in the education of our enginemen. There is no use putting the device on if they don't understand it, and for that purpose it is essential to put out a school car properly equipped with these devices and a lecturer who knows his business and get this stuff across to the enginemen. With that and the enginemen listening and sitting in on these lectures, and then a man accompanying them on the first trip out after the engine is equipped, you will get your maximum results. You will be proud of the results. You will save fuel. There is no question about it.

The problem of keeping the pipes from stopping up with carbon is a real problem. I imagine we worked with 100 or 150 different arrangements before coming to the arrangement which I will describe. (Mr. Fetters then described an arrangement of pipe connections in which the insertion of tees, one branch of which is closed with a plug, permits access for cleaning out the pipe by the removal of the plugs.—EDITOR.)

Mr. Ayers: In working up the standard pipe union did the committee determine whether there was a standard union on the market that came anywhere near meeting the requirements or whether some of the other engineering societies have a standard union that we might use instead of trying to get one of our own?

Mr. Cantley: This started out as a joint proposition between the American Society of Mechanical Engineers, the Mechanical Division and the manufacturers. There is no union exactly like the one that we have here. As a matter of fact, if any of you have gone through the maze of unions that we have gone through, you would find out it would be pretty hard to pick any one of them. The A. R. A. turned this over to our committee to handle, and we thought the best thing to do was to present it to the convention and have it taken up with the manufacturers.

Mr. Fetters: I have had no direct experience with the cast-steel bands, but I understand they are used with considerable success, and as far as this report is concerned I feel that some reference should be made to them.

Mr. Demarest: In the establishment of any spring plant you will centralize your operation. You can absolutely control methods in a central plant but not in scattered plants. You can get the right kind of arrangement in a central plant, but after you do all of that and get your purchasing agent to buy the best steel, you will still have broken springs. You have to do something else.

The first thing that you will have to do is keep a record of your broken springs by classes. You will find some plants use methods that will give no trouble, and others methods that are a continual source of trouble. In nearly a year and a half I have analyzed the location and type of failure of individual springs and classes of springs that have been returned to the spring shop. With the information collected, we have finally got to the place where we have to put it to the man that designs the springs for us.

He can not design a theoretically correct spring, because he has not the space to put it in. Two-thirds of our spring failures are within the band area, and I don't have a fraction of springs slipping in the bands, loose bands, etc.

Mr. Fetters: I believe that the mechanical engineer of today has, of necessity, to go to the enginehouse and live there a great portion of his time. He has to do it because it is the only way he can perfect the design. He can not get it anywhere else. If you will include in these failures the failure of material, and what we have termed malpractice in shops, there is a great deal more to it than the mechanical engineer's design. I think that faulty material and malpractice in shops should shoulder part of the blame.

Mr. Lanning: In view of the fact that most of the bricks hurled by Mr. Demarest came in my direction, I think that I should put up some defense. The crimp that he referred to is the product of the fertile brain of our spring shop foreman, and it has overcome a great deal of the trouble we formerly experienced. Our principal trouble with springs was due to shifting bands, and it brought about such a lot of failures that it gave rise to the steel band referred to by Mr. Purcell. The cast-steel bands have proven to be much more economical than forged bands.

I want to point another thing in connection with springs that comes from my personal experience. I feel that our predecessors in the A. R. A. who formulated specifications for locomotive springs did a pretty good job, except that they were a little too optimistic in regard to the ability of the spring to stand punishment. They gave us a stress of 80,000 lb. per sq. in. to work to in the design of springs and after using that fiber stress for a great many years and getting into trouble, I took it upon myself to arbitrarily depart from it, and we are now using a stress of 75,000 lb. per sq. in. which is giving us a great deal better results.

Mr. Ayers: I would like to ask Mr. Fetters, at the risk of appearing unduly ignorant, whether the committee has had occasion to take up the method of testing the leaves of elliptical springs. My experience a few years ago was that usually the short leaves do most of the breaking. There is usually a gradually increased curvature from the long to the short, and you can easily stress the short leaf up to the limit, but when you do that, think of what you are putting on the long leaf. The long leaf has more stress and the short less, and somewhere in between there is one about normal. When you test a spring like that, you have the stress on the long, and take it off of the short. I think even the automobile spring makers do that to some extent, and I am wondering if the committee developed what happened if the ordinary plate was given the test, so when the spring was banded it would not change the shape at all.

Mr. Fetters: I did not contemplate going into the design of springs as perhaps you notice from the report, although the committee might take that subject up profitably, I think, this coming year. We have heard this same subject discussed that you bring up, and there is no question but what that is responsible for a great deal of damage to short springs. I think that is also brought out by the fact that we have had so much less breaking in what we term the reverse cantilever spring in the last four or five years.

Mr. Rink: I would like to call the attention of the members to a failure in the top spring plate of a spring used on heavy locomotives where a U-shaped hanger was used with a cast-steel clip. The clip had a projection that set down off the flap due to imperfections in the casting and a little too heavy a filling, and it caused these top plates to creep out through the slot. It is the only type of failure we encountered in the springs in over 18 months of service, indicating that the spring was

properly designed, but due to the spring clips not being properly examined before their application, these failures occurred.

I don't agree with Mr. Demarest, when he states that all springs should be dismantled, if I understood him correctly, as soon as they pass through the shops. We take out springs and put them on the testing machine and if they test properly and no cracks are observed in making the final inspection, these springs go right back on the locomotives. I don't believe we should go to the unnecessary expense of stripping all springs.

Mr. Demarest: I don't want the last speaker to misunderstand me. I didn't recommend that practice as a general practice. I did say it was a practice that we had inaugurated and just how long we will maintain it, I don't know. I do know this, that as long as we simply tested out the springs as they came in, and if they tested properly put them back in service, we had no idea at all of the relative age and length of time the plates had been in service or how far they had been operated to their stress and failure point. We don't know how many are broken in the band. It is a curious thing, but you will find springs with leaves broken in the band that will test just as if there was not a broken leaf and you have got no knowledge of that condition at all until gradually, on the road, the leaf works out.

The report was accepted and a rising vote of thanks extended to the committee.

Utilization of Locomotives and Conservation of Fuel

T. B. Hamilton
Chairman

As no requests were received from any carriers during the year, no field surveys were made by the sub-committee. Accumulative quarterly reports for the first three quarters of 1928 were issued; the last quarterly report is combined with this annual report.

Volume and unit data are shown in this report to indicate trends and factors by years for Class I carriers as a whole and in some instances for 26 selected individual carriers. Analysis have been divided between freight, passenger and yard services. Available yard service data referred to in this report was taken from reports accumulated by the Bureau of Railway Economics.

Freight Service Volumes

Chart A reflects trends for Class I carriers as a whole, by percentages of increase or decrease each year compared with 1920. The total number of freight locomotives active has been declining in relation to volume of traffic since 1924, and as there is a continuation of replacement of smaller obsolete with larger modern locomotives, it is expected the number active will continue to decrease in relation to traffic volumes. Total train and locomotive miles, train hours and tons of fuel consumed have continued to decrease regardless of increase in traffic volume. Total train miles, locomotive miles and train hours decreased because of reduction in number of trains, as a result of increased train tonnage, aided by increased speed. The reduction in tons of fuel consumed was brought about by reduction in train hours and miles, also to improved type and size of locomotives, reduction in locomotive miles and number active, and fuel conservation activities in general.

Unit Freight Service Performances

Where the increase in volume of traffic is general and uniform, opportunities for improvements in unit train performances increase. This condition permits building up more average tonnage per train without increasing the relative number of trains. In fact the marked reduction in train miles and hours indicates that the improvement in train tonnage has more than offset the increase in volumes.

Chart B shows the trends in percentages of increase or decrease each year compared with 1920 for Class I carriers. Chart C shows the trends of 1928 compared with 1920 for 26 individual carriers, the details of which are taken from the enclosed exhibits.

The train speed as reported is the train miles run from initial to final terminals divided by the time consumed, including intermediate stops, delays, etc. This train speed in no way indicates average running speed; running speed is variable. The train speed, as recorded, was 25.3 per cent greater in 1928 than in 1920 for Class I carriers; each of the 26 carriers shown on Chart C had a greater speed in 1928 than in 1920. This increase in speed was brought about by the use of larger locomotives, better train assembly works at initial terminals as to preclassification, reduction in intermediate yard work, improved dispatching, reduction in intermediate stops for signals, sidings, etc., and increased capacity of tenders, the latter decreasing the relative number of stops for water and fuel. Further improvements in train operation can be made by increasing the lengths of automatic or controlled manual block systems, installation of lap sidings, remote-control switches, relocation of roadway fuel and water stations, adequate sidings, facing-point cross-overs, as they have a decided influence on the number of locomotive hours required to move trains from initial to final terminals.

Train tonnage was 27.4 per cent greater in 1928 than in 1920, whereas volume of traffic was 21 per cent greater, so that train loading improved to a greater extent than the volume contributed thereto.

The resultant hourly speed-load factor, or gross ton miles per train hour, which also represents the trailing gross ton-miles per locomotive train hour, increased 59 per cent in 1928 over 1920 for Class I Carriers. Some of the 26 carriers shown on Chart C exceeded this increase, and some had lesser increases. The result in gross ton-miles is obtained either by heavy train-

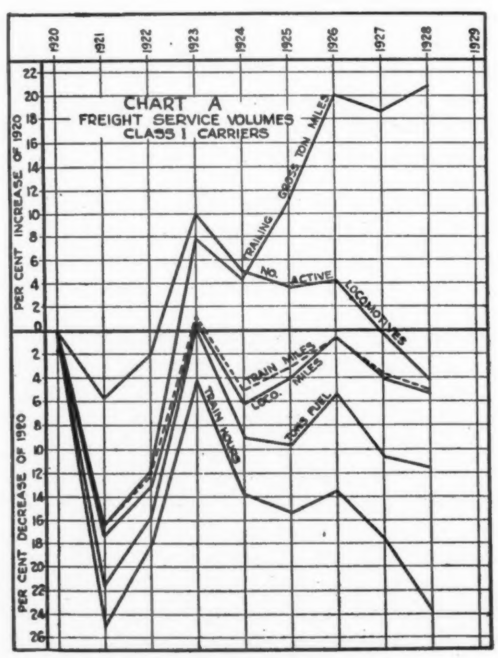


Chart A—Trends of freight service volumes from 1920 to 1928 for Class 1 roads

tonnage and low speed, or normal tonnage and high speed Chart C shows extremes in this respect.

The 1920 hourly speed-load factors were low. Doubtless economies have resulted from an increase in this factor. An attempt to calculate the economies resulting from such increase would involve the application of equation factors in costs of

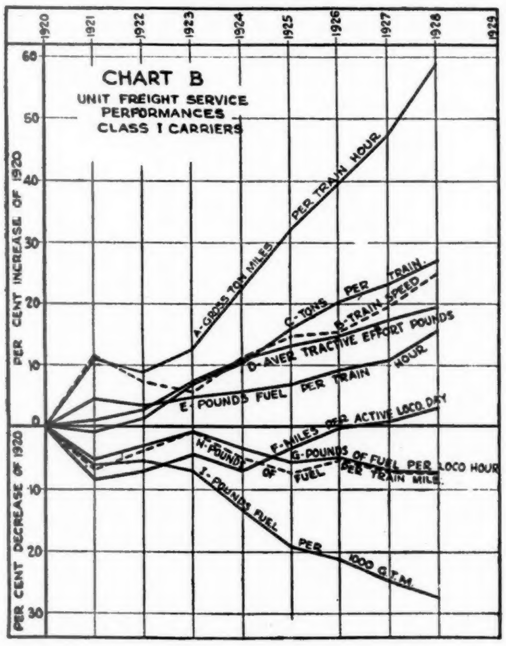


Chart B—Unit freight service performance trends from 1920 to 1928 for Class 1 roads

labor, material, etc. Your committee has not, therefore, attempted to develop such savings, because of the multitude of equation to be encountered. The factors of economy depend upon bridge, yard, roadway and other limitations as well as the size of locomotives and the art of conducting transportation.

The improvements thus far noted have been on the hourly basis. While the work done per active locomotive-hour on train has increased 59 per cent, the work done per day has increased only 32.3 per cent, due to decrease in locomotive train-hours of service per day, brought about by increased speed. A comparison by years for Class I carriers shows the trends in work done per active locomotive-train-hour and per day.

Work Trends Per Train-hour and Per Locomotive-Day

	Trailing gross ton-miles per	
	Train hour	Active loco.-day
1920	14,877	108,119
1921	16,555	99,930
1922	16,188	100,450
1923	16,764	100,794
1924	18,257	112,833
1925	19,685	122,253
1926	20,692	130,849
1927	21,940	134,938
1928	23,652	143,024

Since the work done per hour and per mile has materially increased, it becomes a question of further increasing the work per day by further reducing the number of locomotives active by means of increasing the number of more than single-crew runs and reducing the non-productive terminal layover time.

Freight Locomotive Mileage

Locomotive mileage is classified as principal, helper and light. Principal mileage is that of locomotives on and principal to train; helper mileage is that of additional locomotive while on train; light mileage is that of helpers returning light, running light because of unbalanced traffic and running between trains and enginehouses. The locomotive mileage called for by the OS-A reports is the total of these, except road switching. The amount of road switching has been found to vary from 4.3 per cent to 1 per cent of the total, depending on local conditions. The miles per active locomotive day previously reported have been based on total mileage exclusive of road switching. Further division is now made to show the miles per active locomotive day on trains, whether one or more locomotives.

For 1920 the total miles per active locomotive-day were reported as 88.9. Owing to numerous inquiries a further investigation was made and it was found that all of the active units were not reported for that year, and when adjusted this was found to give 85.2 miles.

One of the tables has been developed to indicate the distribution of hours per active locomotive day, divided between hours on train, hours consumed at terminals and hours non-productive. The average time required per active locomotive for terminal handling is estimated, based on observations made in field surveys of the sub-committee.

Miles Per Active Locomotive Day

	Principal, helper and light (1)	Principal, helper on train (2)	Light (3)	Train hours of service (4)
1920	85.2	74.9	10.3	7.27
1921	78.1	69.6	8.5	6.05
1922	79.2	70.5	8.7	6.46
1923	81.5	72.1	9.4	6.50
1924	79.4	84.0	5.4	6.43
1925	82.3	73.2	8.9	6.20
1926	85.1	75.2	9.9	6.33
1927	85.5	74.5	11.0	6.05
1928	88.0	77.9	10.1	6.04

(1) is total locomotive-miles per day divided by number of locomotives active.
(2) is total train-miles per day divided by number of locomotives active.
(3) is difference between (1) and (2).
(4) is total train-miles per day divided by train speed.

For each year 10.5 hours per day have been applied for terminal detention, but this has doubtless varied. As an average condition, field surveys indicate one hour as movement from train into house, and this varies with the terminal layout. The six hours for repairs also vary greatly, depending upon the intensity with which locomotives are called, the forces and facilities employed, and the policy as to relation of running repairs to classified repairs. The preparatory time has been calculated at 1.5 hours, but this has been found to vary with roundhouse facilities. With hot water and direct steaming plants this can be reduced to about .75 hours or less. The re-

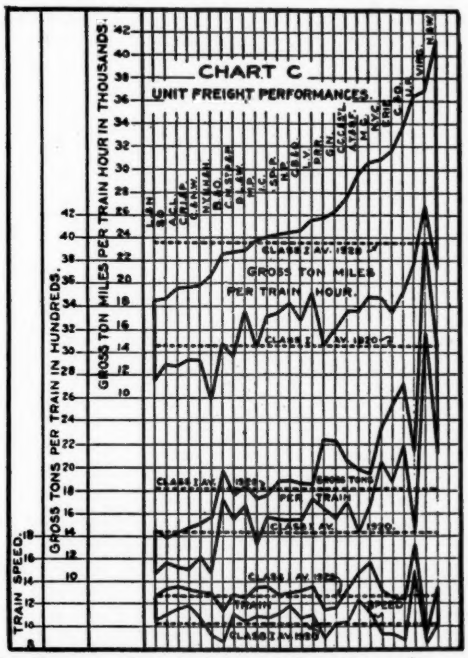


Chart C—Comparative freight performances for individual roads in 1920 and 1928

Distribution of Average Hours Per Active Locomotive-Day

	On train	Moving to r. h. yard	Moving into r. h.	Repairs	Preparatory time	Moving out of r. h.	Moving to train	Non-Productive time
.920	7.27	.75	.75	6.00	1.5	.75	.75	6.23
1921	6.05	.75	.75	6.00	1.5	.75	.75	7.45
1922	6.46	.75	.75	6.00	1.5	.75	.75	7.04
1923	6.50	.75	.75	6.00	1.5	.75	.75	7.10
1924	6.43	.75	.75	6.00	1.5	.75	.75	7.17
1925	6.20	.75	.75	6.00	1.5	.75	.75	7.30
1926	6.33	.75	.75	6.00	1.5	.75	.75	7.17
1927	6.05	.75	.75	6.00	1.5	.75	.75	7.45
1928	6.04	.75	.75	6.00	1.5	.75	.75	7.46

sult in non-productive hours per day emphasizes the fact that increased utilization is not accomplished with long runs if the layover periods are increased in proportion, and if the shorter trips per day per active unit do not exceed one. Where a unit does not make a trip in the established 24-hour period it should not be counted as active (See form OS-A). The preparatory time does not begin until called, but the time awaiting call is considered as non-productive and is included in the non-production time.

The illustration of the distribution of daily hours of service is not clear so far as number of trips per day is concerned. Therefore this calculation has been translated into average monthly performance. This implies returning the locomotive to service as soon as ready, and by reducing the terminal and non-productive hours, increasing the number of trips accordingly; with the same train mileage and train speed. The year 1928 is used as the basis.

Average Distribution of Daily Hours of Service

Hours on train	6	6	6	6	6
Terminal layover	18	17	16	15	14
Trips per month	30	31.3	33.0	34.0	36.0
Trips per day	1	1.04	1.1	1.13	1.2
Miles per month	2,340	2,441	2,574	2,714	2,808
Miles per day	78	81.3	85.8	90.4	93.6
Number active	21,118	20,243	19,191	18,206	17,242
G.t.-m. per active loco.-day	143,024	148,745	157,326	161,617	171,629

This is an illustration of the fact that in addition to increasing the number of extended locomotive runs, utilization can be further increased by increasing the relative number of single trips per 24-hour day. A reduction in the relative amount of layover time in relation to road work is essential in bringing about more road work per active locomotive day as it decreases the number needed, for the work necessary to be performed.

Two general conditions have been found in field surveys. One was where the carrier was relatively long on power, thus holding locomotives in roundhouses longer periods and using smaller forces; the other was where the carrier was relatively short of power, requiring rapid turning with larger forces. In either case the miles per day on trains will be high or low according to distance between terminals and many other factors, and according to the manner in which locomotives are reported on the OS-A forms.

The number of freight locomotives reported on the day basis (OS-A) for Class I carriers by years is shown in one of the tables.

Number and Condition of Freight Locomotives

	Total	Serviceable	Unserviceable	Stored	Active
1920	30,080	22,762	7,318	669	22,093
1921	32,936	25,030	7,906	4,190	20,840
1922	32,940	24,536	8,404	2,932	21,604
1923	32,966	25,858	7,123	1,478	24,365
1924	33,240	25,843	6,237	3,771	23,232
1925	32,419	26,663	5,756	3,719	22,944
1926	31,652	26,459	5,193	3,448	23,011
1927	30,997	26,006	4,991	3,927	22,079
1928	30,242	25,309	4,933	4,190	21,119

In comparing 1928 with 1920, the total number of freight locomotives reported on OS-A forms for Class I carriers increased by 162, or 0.5 per cent; the number serviceable increases by 2,547, or 11.2 per cent; the number unserviceable decreased 2,385, or 32.6 per cent; the number stored increased by 3,521; and the number active decreased by 974, or 4.4 per cent.

Passenger Service Volumes for Class I Carriers

	Thousand train-miles	Thousand loco.-miles	Million car-miles	Thousand tons fuel
1920	555,201	583,774	3,580	33,671
1921	544,532	568,565	3,462	30,706
1922	531,477	556,338	3,405	30,430
1923	549,817	577,187	3,577	32,287
1924	553,166	577,769	3,632	30,806
1925	552,412	577,728	3,717	29,910
1926	550,710	576,771	3,793	30,015
1927	539,148	563,866	3,769	28,990
1928	521,349	545,071	3,719	27,867

Further decrease in the number active is looked for in view of the fact that the decrease of 4.4 per cent is not entirely commensurate with 5 per cent decrease in train mileage.

Passenger Service Performances

The trends in volumes for Class I carriers, by percentages of increase or decrease compared with 1920 are shown in one of the tables. Train and locomotive miles and tons of fuel consumed continued to decrease, while total car miles were still greater in 1928 than in 1920.

Passenger service data called for is not in as much detail as freight data, particularly as to train speed, tons per train and gross ton-miles per train-hour.

One table shows the unit passenger locomotive and train performances for Class I carriers, by years.

Unit Passenger Service Performances

	Miles per active loco.-day	Cars per train	Pounds fuel per Car-mile	Loco.-mile	Train-mile
1920	142.4	6.4	18.8	115.4	121.3
1921	142.3	6.4	17.7	108.0	112.1
1922	140.3	6.4	17.9	109.4	115.0
1923	142.3	6.5	18.1	111.9	117.4
1924	143.0	6.6	17.0	106.6	111.4
1925	147.7	6.7	16.1	103.5	108.2
1926	151.9	6.89	15.8	104.1	109.0
1927	154.0	6.99	15.4	102.8	107.6
1928	158.3	7.13	15.0	102.2	106.8

The decline in total locomotive miles has been quite proportional to the decline in total train miles, yet in face of a decline in volume the miles per active locomotive-day have increased, representing more mileage work and more car-mile work, in that the cars per train and therefore the train tonnage have increased. Since no speed data is available it is not possible to state in what respect the speed-load factor has been affected by speed as compared with tonnage per train. If the average terminal-to-terminal speed were 30 miles per hour this would indicate an average of about five hours per day on trains, and if increased on an assumed basis of two runs instead of one, would mean 10 hours per day and 12 hours for layover. It emphasizes the possibility of increasing the average number of trips per day or month in addition to further

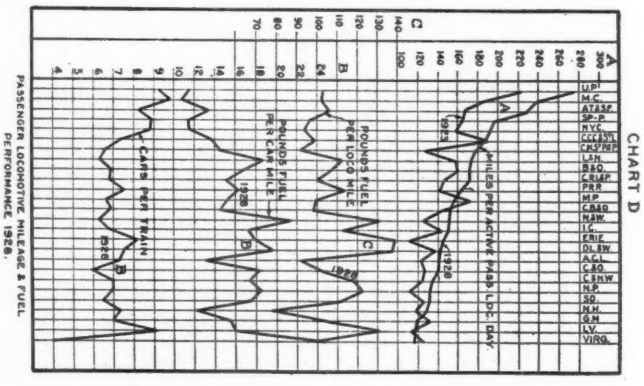


Chart D—Comparative passenger locomotive performance for individual roads in 1923 and 1928

increasing the number of long runs consistent with balanced assignments when traffic density varies.

The pounds of fuel consumed per locomotive mile has decreased even though the cars per train have increased; the trends being quite relative to freight service in this respect. The pounds of fuel per car mile have decreased in greater proportion than the increases in cars per train.

Chart D shows the performance of the 26 carriers, comparing 1928 with 1923. This shows that the 1928 performance in miles per active locomotive day was greater in 1928 than in 1923 in all but four cases. The pounds of fuel per locomotive mile do not vary directly with the miles per day, but have other characteristics affecting them, such as type, design and maintenance of locomotives, operating conditions, etc. The pounds of fuel per car mile vary quite inversely with the cars per train but the number of cars per train does not appear to affect the pounds of fuel per locomotive mile.

Number of Passenger Locomotives

	Total	Serviceable	Unserviceable	Stored	Active
1921	15,066	11,587	3,479	644	10,943
1922	14,993	11,472	3,521	606	10,866
1923	14,555	11,522	3,033	433	11,089
1924	14,554	11,865	2,689	794	11,071
1925	14,341	11,789	2,552	1,036	10,753
1926	13,882	11,517	2,365	1,109	10,408
1927	13,511	11,288	2,223	1,256	10,032
1928	12,989	10,857	2,132	1,452	9,405

One table shows the number of passenger locomotives as reported on the OS-A forms by Class I carriers.

In comparing 1928 with 1921, the total number of passenger locomotives reported on OS-B forms for Class I carriers decreased 2,077 or 13.7 per cent; the number serviceable decreased 730 or 6.3 per cent; the number unserviceable decreased 1,347 or 38.7 per cent; the number stored increased 808 or 12.5 per cent, and the number active decreased 1,538 or 14.0 per cent. During this time, train miles decreased 7.1 per cent, and miles per active locomotive-day increased 11.4 per cent.

Yard-Locomotive Performance Volumes

The trends in volumes relating to yard locomotives for Class I carriers, by years, are shown in one of the tables.

Yard Locomotive Volume Trends (All Expressed in Thousands)

	Miles	Hours	Equivalent shifts	Tons fuel
1920	356,947	59,491	7,436	24,338
1921	264,596	44,098	5,512	18,237
1922	284,161	47,360	5,920	19,495
1923	342,215	57,036	7,129	24,068
1924	315,897	52,649	6,581	21,974
1925	324,208	54,035	6,754	22,176
1926	339.657	56,610	7,076	23,269
1927	323,894	53,982	6,748	21,775
1928	316,974	52,829	6,605	29,834

Since yard-locomotive miles are arbitrary, or six miles per hour, the mileage and hours are relative. The total number of equivalent shifts is the total hours divided by eight hours per shift, so that this data is also relative. The tons of fuel consumed have fluctuated in approximately direct proportion with the total hours; the year 1927 being the first instance when the total amount of fuel consumed decreased more than the total hours.

An analysis of the amount of yard-locomotive hours in relation to road work shows that for freight service the amount of yard locomotive mileage has declined in greater proportion than freight-train mileage and has continued to decline in relation to the total trailing gross ton-miles. Apparently this is due to increasing the proportion of through trains and reducing intermediate yard work for revision of tonnage and train assembly. For passenger service the relative amount of yard work has increased in proportion to train miles, occasioned by handling more cars per train and also to the lack of yard density work.

The total number of yard locomotives reported on the CS 56A reports (which is the only available basis) for Class I carriers, is shown in tabular form.

Number and Condition of Yard Locomotives (Class 1 Carriers)

	Total	Serviceable	Unserviceable	Stored	Active
1923	15,592	13,463	2,129	630	12,833
1924	15,963	13,643	2,320	784	12,859
1925	15,978	13,857	2,121	830	13,027
1926	15,899	14,115	1,784	774	13,341
1927	15,603	13,849	1,754	1,367	12,482
1928	15,248	13,533	1,715	1,159	12,374

Since 1923, the total number was decreased by 344 units, the serviceable increased by 70, the unserviceable decreased 414, the stored increased 529, and the active decreased 459 units. The reduction in number active was 3.5 per cent and the equivalent number of shifts worked per day decreased 4.1 per cent. The following table shows the miles per active yard-locomotive-day, the average number of hours and equivalent shifts per day for Class I carriers.

Utilization Secured With Yard Locomotives

	Miles per active loco.-day	Hours worked per active loco.-day	Equivalent shifts per active loco.-day
1923	73.0	12.16	1.52
1924	67.3	11.20	1.40
1925	68.1	11.35	1.42
1926	69.7	11.60	1.45
1927	71.1	11.85	1.48
1928	70.0	11.66	1.46

The hours and shifts per day are affected by the relation of industrial and light or periodical yard work to heavy constant and concentrated yard work. In the latter case experiments have been made with locomotives working three shifts per day between monthly test periods, with considerable success. But the proportion of daily periodic work at industries and in yards where the work is not constant, brings the average considerably below three shifts per day. It is a matter of studying each yard condition as to what can be done to reduce the number of yard locomotives in service. A daily service of 11.66 hours indicates an average layover of 12.34 hours, which is more than needed. An increase from 1.46 shifts to 2.0 shifts per day would, all other conditions being equal, be equivalent to reducing the number active by about 3,000. This would mean an 8-hour instead of a 12-hour layover out of every 24 hours.

Counting Number of Locomotives

There is confusion concerning the method of counting locomotives so far as the number active is concerned. The method used here in no way is involved in any method used by mechanical officers in establishing condition of power for shopping purposes. We find little similarity in methods used by various mechanical officers in this respect, some counting as stored those not making a trip only after a certain number of idle days, others not permitting units to be counted as stored unless good for a certain number of months of service. Their method in this respect is immaterial so far as the O S reports are concerned.

The data used to arrive at the information for this report is taken from the OS-A forms for freight service, and OS-B forms for passenger service. These forms are usually prepared by the car accountant or in some branch of the accounting department, and seldom if at all by the mechanical officers. The reports received by the accounting officers may come from various sources, in some cases from superintendents or other departments. Some carriers have gone so far as to count the number active from the train sheets, which method does show results quite accurately. If mechanical officers will interest themselves in the OS forms to see how they are compiled as called for by the Interstate Commerce Commission, apparent discrepancies will disappear.

The OS-A and OS-B forms are identical in this respect. For instance, OS-A form provides:

(Note H) Items 12 to 15.
(12) Average number serviceable (including stored).
(13) Average number unserviceable.
(14) Average number on line.
(15) Average number of locomotives stored (included in Item 12).

shall be counted to include those owned, leased and rented in freight service during the month (excluding those on other roads), obtainable by dividing the total number of locomotive-days of 24 hours assignable to freight service by the number of calendar days in the month.

This constitutes the day basis of counting, and as the calendar month ends at midnight, we conclude the calendar day ends at midnight.

Stored Locomotives to be Counted on the Day Basis

The application of the detailed instructions to item (15) is that the stored unit is to be included in item (12), number serviceable. Therefore, stored units are to be counted on the day basis likewise. Any serviceable unit not in service in a 24-hour day period is therefore a stored unit and should be so counted for OS purposes.

Item (15) defines a stored locomotive as one under white-lead or stored in serviceable condition and available for service. This method of counting has not been followed closely in that the number stored are considered only those in white-lead, or some slight modification thereof. The counting of stored units is emphasized because it is necessary to deduct them from the number serviceable to obtain the number active.

For passenger locomotives the instructions are identical (see OS-B, items 8, 9, 10 and 11, notes D and E.)

No such data is called for to cover yard locomotives, and as units used in yard service vary greatly because of partial assignments of road power to yard service, the counting on ownership basis is inaccurate. The only source used periodically for yard locomotives is the CS56A report, based on ownership. This report shows the total owned, divided between serviceable, unserviceable and stored. The number unserviceable for running repairs are counted on the basis of requiring 24-man-hours or more instead of the day basis. During the year question was raised with the Car Service Division as to changing the CS56A reports to the day basis, and thus eliminate apparent confusion with the OS reports, likewise reducing the expense

of making reports on different bases. Thus far this change has not been agreed to.

Conditions and Shopping of Locomotives

Shopping requirements have decreased rather than increased because of increased utilization of locomotives. There is evidence of the number of back shops having been reduced, thus concentrating shop work and permitting better classification and grouping of work. Roundhouse and back-shop requirements are based on the amount of mileage to be restored in relation to the mileage run. Reducing the number of locomotives, as has occurred, and increasing the mileage run per unit, increases the shopping frequency, but this is offset by maintaining fewer units.

A comparison of 1923 and 1928 shows the following condition and surplus locomotives in percentages of totals for Class I carriers.

Percentages of Surplus Locomotives

	Freight		Passenger		Yard	
	1923 Per cent	1928 Per cent	1923 Per cent	1928 Per cent	1923 Per cent	1928 Per cent
Serviceable ..	78.8	83.6	79.1	83.6	86.3	88.7
Unserviceable.	21.2	16.3	20.9	16.4	13.7	11.3
Stored	4.5	13.8	3.0	11.2	4.0	7.6
Active	74.3	69.8	76.1	72.4	82.3	81.1
Reduction in total number		7.7		10.0		2.0

In each case there was a reduction in the total number, and increase in proportion serviceable and stored and a decrease in proportion unserviceable and active.

Analysis of the CS56A reports for 1928 shows the following in percentages for Class I carriers as to output of classified repairs.

Percentage Output of Classified Repairs

	Freight, per cent	Passenger, per cent	Yard, per cent	Total, per cent
Class 1	0.4	0.6	0.4	0.4
Class 2	5.4	4.7	3.0	4.0
Class 3	24.0	24.4	20.0	23.0
Class 4	11.0	11.5	9.0	11.0
Class 5	22.2	27.0	18.0	22.0
Total	63.0	68.2	50.4	60.4
Average miles	21,728	42,922	21,825	26,107

Passenger locomotives have a greater frequency of classified repairs than freight or yard locomotives, because of greater mileage run, but the increase in passenger-locomotive repair frequency is not in proportion to that of other types because the miles between shopping are greater. The frequency of shopping passenger locomotives is about once every 17.5 months, for freight locomotives about once every 19.2 months and for yard locomotives about once every 24 months.

The data as to average miles between classified repairs will doubtless not compare with that of individual carriers having a method of breaking mileage different from that of any class of repairs. Some carriers break mileage after Class 3 repairs, some after any class of repairs. This data is based on any classified repairs reported on form CS56A, for Class I carriers. The averages shown are exceeded in many cases, and it has been the experience of some carriers that as the mileage accumulation increases per day, per month, etc., the mileage between classified repairs increases. Advance inspection and reports of condition make it possible for shops to do considerable preliminary work, thus reducing the number of days undergoing repairs.

The volume of traffic throughout the year is seasonal. The number of locomotives active does not decrease in proportion to decrease in traffic volume, due to not counting as stored the units not working in a 24-hour day, and to the fact that increased number of scheduled trains results in running trains at less than rating in low-volume periods. If the speed-load factors in low-volume periods are made more nearly average, regardless of volume fluctuations, the number of locomotives active will fluctuate more nearly with volume of traffic. Nevertheless, the surplus locomotives in the number stored is sufficient to handle the peak loads, so that the number of locomotives available for shopping should insure a constant, but minimum, shop force and use of shop equipment.

Analysis of the CS56A reports as to output of running repairs in each case requiring more than 24 man hours shows that each active passenger locomotive received 142 such repairs, each active freight locomotive received 131 such repairs and each yard locomotive received 92 such repairs per year. It indicates that if previous recommendations were more fully followed to do thorough work at monthly test time so as to decrease the amount of intermediate work, these frequencies would be reduced.

By reducing the relative number of locomotives active the mileage run per active unit will accumulate more rapidly, increasing back-shop frequency but not increasing back-shop work because of fewer units maintained. The frequency of running repairs requiring more than 24 man hours can be decreased by doing the necessary work at monthly tests, so that the work required meanwhile will be reduced to a minimum.

Economies of Operation

In the last annual report reference was made to savings from long locomotive runs. All of the items referred to are not readily available. Since long runs are confined to districts and expenses by districts affected are not always obtainable without special records, it is not possible to arrive at accurate data. However, it would seem that savings in running repairs, enginehouse expense and fuel can be arrived at. Where the repair-turning frequency is reduced it is expected that the cost per mile will decline. Likewise where the frequency of enginehouse turning is reduced in relation to miles run, there should be a reduction in cost per mile for enginehouse expense. The reduction in turning frequency will also save fuel, which saving will be large or small depending somewhat on terminal facilities. Savings accrue in interest and depreciation charges as the relative number of locomotives is ultimately reduced under long-run or frequent-trip service as compared with short runs and infrequent trip service.

In operation, savings accrue from elimination of unnecessary train stops. Larger tenders to reduce stops for fuel and water, result in savings, and reduction of frequency of such roadway facilities further add to the savings.

Locomotive Fuel Performance

During the year quarterly reports have contained available fuel data for freight and passenger service. For yard service the fuel data is compiled once for the year.

The total tons consumed in each of the other classes of locomotive service as reported, including equations for oil and current, are shown by years for Class I carriers.

Total Tons Consumed by Locomotives (Thousands)

	Freight	Passenger	Yard	Total
1920	89,925	33,671	24,338	147,834
1921	70,303	30,706	18,237	119,246
1922	75,694	30,430	19,495	125,619
1923	90,263	32,287	24,068	146,618
1924	81,025	30,806	21,974	133,805
1925	81,316	29,910	22,176	133,402
1926	85,095	30,015	23,269	138,379
1927	80,427	28,990	21,775	131,179
1928	79,311	27,867	20,834	128,012

The volume of freight service increased 21 per cent in 1928 over 1920 and the total tons of fuel consumed decreased 11.8 per cent in this period. If the total trailing gross ton-miles of 1928 had been hauled at the number of pounds of fuel per 1,000 gross ton-miles prevailing in 1920, Class I carriers would have consumed approximately 29,000,000 more tons of fuel in freight service in 1928. In passenger service, if the pounds of fuel per train-mile consumed in 1920 had prevailed in 1928, there would have been an increased consumption of approximately 3,800,000 tons. Likewise in yard service there would have been an increase of 783,000 tons. No information is available as to comparative quality of fuel in these periods. Reductions in relative amounts of fuel consumed were brought about by improved locomotive design and maintenance and reduction in number active; improved train assembly and speed-load factors; improved terminal layouts and roadway facilities for uninterrupted train movement. Improvements in the methods of conducting transportation have contributed largely to the reduction in amount of fuel used.

Fuel Consumed in Freight Service

In freight service the unit fuel performances for Class I carriers were as shown in the table.

The consumption per work-hour has shown a slightly better trend than per work-day, because the work done per hour has increased more than the work done per day. In both cases, however, the reduction in fuel consumption in relation to work done has been affected by the reduction in the number of locomotives active.

Chart B indicates the relation of train tonnage and speed to the rate of fuel consumption per train-hour, showing that as

Unit Fuel Performances in Freight Service

	Pounds per 1,000 GTM.		Pounds fuel per			
	Inc. loco.	Exc. loco.	Train-hour	Loco.-day	Train-mile	Loco.-mile
1920	170	197	2,928	21,470	283.8	252.3
1921	162	185	3,060	18,478	265.2	236.4
1922	163	186	3,015	17,756	272.3	242.2
1923	161	183	3,065	19,087	281.3	248.8
1924	149	170	3,101	20,104	269.7	240.7
1925	140	159	3,128	19,406	263.8	235.8
1926	137	155	3,204	20,271	268.9	238.3
1927	131	148	3,247	19,956	263.4	233.4
1928	127	143	3,393	20,513	263.6	233.1

conditions are brought about by larger and better locomotives, more tonnage per train and less delays enroute, the rate of fuel consumed does not increase in proportion. This also applies to the work done and fuel consumed per day. The rate of fuel consumption referred to includes all locomotive fuel used, that is, in light mileage, on trains, and firing up and cooling down at terminals.

The unit performances of the 26 carriers, comparing 1920 with 1928, are shown on Chart E, illustrating the trends of gross ton-miles per train-hour compared with pounds of fuel per 1,000 gross ton-miles. This shows that as the gross ton-miles per train-hour increase, the pounds of fuel consumed per 1,000 gross ton-miles decrease, the irregular variation in fuel consumption being due to difference in grade, curvature, fuel, water and traffic conditions. Fuel equations vary also. In the case of electric operation, the speed-load factor is high, attained by low speed and heavy tonnage because in electric operation the initial rating is higher than the continuous rating, a condition quite the reverse of steam operation.

Since 1923, train and locomotive miles have been conserved in relation to car-miles hauled, with a result in reduction of total

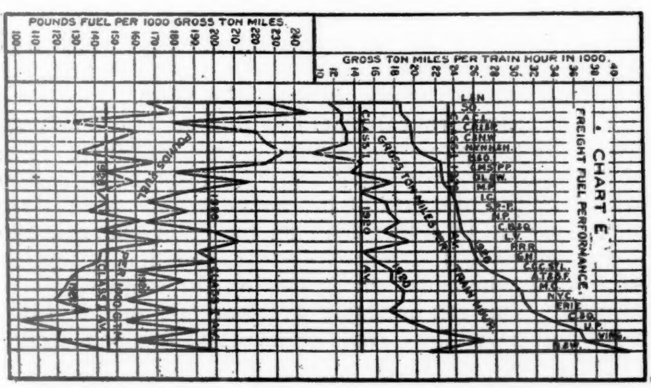


Chart E—Comparative freight locomotive performance for individual roads in 1920 and 1928

tons of fuel used. With an increase in cars per train and miles per active locomotive day, there has been a continued reduction in pounds of fuel consumed per locomotive-mile, per train-mile and per car-mile. Changes in type and design of passenger locomotives taking place in this period cannot be reduced to a comparative factor. As the number of active locomotives increases, there is a reduction in the rate of fuel consumption for a given amount of work.

Unit Performances in Switching Service

	Miles per active loco.-day	Pounds fuel per		Tons per	
		Loco.-mile	Loco.-hour	Day	Shift
1920		136.4	818.4		
1921		137.8	826.8		
1922		137.2	823.2		
1923	73.0	140.7	844.2	5.13	3.38
1924	67.3	139.1	834.6	4.68	3.34
1925	68.1	136.8	820.8	4.65	3.23
1926	69.7	137.0	822.0	4.65	3.29
1927	71.1	134.4	806.4	4.78	3.23
1928	70.0	131.4	788.4	4.60	3.15

Fuel Consumed in Yard Service

For Class I carriers the performances as to miles per active locomotive-day and pounds of fuel per mile are shown in tabular form.

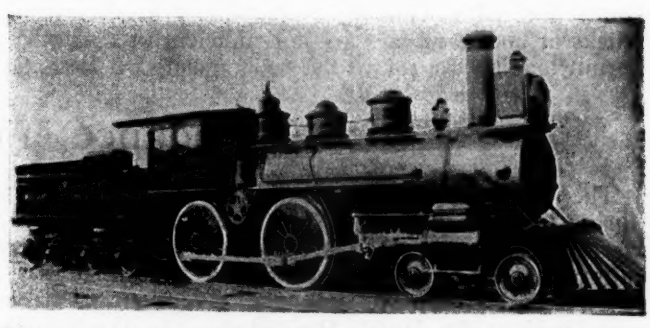
This shows that since 1920 there has been little fluctuation in the pounds of fuel per yard-locomotive-mile, hour or shift. In comparing 1928 with 1923, the miles per day were 4.1 per cent less in 1928 whereas, the pounds of fuel were 6.3 per cent less per mile, indicating some relative reduction in fuel consumption. Generally, advantages in reducing the number of yard locomotives worked, by increasing the hours, miles and shifts per day per locomotives worked, will result in economies as to fuel, repairs and enginehouse experience per unit of work done. The problem of providing modern switch power in place of assigning obsolete road power to yard service is worthy of consideration as to comparative operating expenses and investment cost. Apparently much remains to be done to improve the utilization of yard power so far as constructive and continuous work is concerned.

Representing the Operating Division, the report is signed by T. B. Hamilton, vice-president, Western region, Pennsylvania; J. T. Gillick, chief operating officer, Chicago, Milwaukee, St. Paul & Pacific, and R. E. Woodruff, assistant vice-president, Erie. Representing the Mechanical Division; the report is signed by W. H. Flynn, general superintendent motive power and rolling stock, New York Central; O. S. Jackson, general superintendent motive power and machinery, Union Pacific; O. A. Garber, chief mechanical officer, Missouri Pacific.

Discussion

Mr. Demarest: The subject matter of this report is altogether too vital to let it go by without getting some good out of it. Two things are referred to which should be a matter of grave concern to all of us. First, the miles per day per active locomotive. You cannot stress that too much because ton-mileage per locomotive has been increasing; still you must use the miles per dispatchment, which is in effect miles per day, as the measure of the amount of road work you are getting out of a locomotive. Second, is the reduction in the amount of useful time. Out of every 24-hour day the reports from the railroads indicate that only 6½ of those hours are being spent in pulling a train. Why should not a locomotive be pulling a train for 12 hours out of 24. That is getting only 50 per cent out of the value of your investment.

How can we do it? I realize in our own situation on the Pennsylvania that we have not gone as far as we could. We think perhaps we have got limitations in some directions that prevent us from going much further. I believe that your committee in addition to giving us these statistical data, should devote some attention during the coming year to the possibilities in the direction of getting more gross tons per month out of locomotives. The question of counting your locomotives uniformly is also important. We must have a uniform method of counting to render comparison of any value. Operations today



Morgan's Louisiana & Texas 4-4-0 type locomotive No. 47—Built by Baldwin in 1884—16-in. by 24-in. cylinders; 62-in. diameter drivers; 130-lb. boiler pressure—Tractive force 10,940 lb.

have developed largely on the basis of the elimination of the small units. On March 1, 1920, when the railroads were turned back to their owners, the Pennsylvania had, in round numbers, 7500 locomotives. Since that time we have cut up 2200 and are operating today with about 6800. We have a program in front of us that may take ten years or more to accomplish, for we have something like 3300 locomotives to eliminate yet. When we get down to that basis we will be operating the Pennsylvania System with something like 4800 separate units as compared with 7600 on March 1, 1920. We figure that every locomotive we take out of service saves us $4,000 a month, that is for maintenance and other expense.

Mr. Chambers: I want to ask Mr. Demarest about reducing his number of locomotives from approximately 7500 or 7600 down to about 4800, whether he is taking into consideration how many locomotives in the future will be replaced by electrical operation.

Mr. Demarest: The Pennsylvania System has an electrical program ahead of it which will take in the territory from New York to Washington and some portions of the freight lines. I have not, in giving you those figures, taken into consideration that steam locomotives would be replaced in any way by electrical locomotives, but I have given you the analysis based on our complete data. Naturally, to follow out Mr. Chambers question, therefore, if we replace steam locomotives by electrical units, we will not put as many electrical units in service as we took out steam units.

The report was received and the committee continued.

Report of Joint Committee on Reclamation

Your committee submits a progress report of activities for the year. For the purpose of obtaining direct information of reclamation practices in effect on the various railroads, a questionnaire was submitted to the mechanical officers of Class I railroads covering 16 major reclaimable items of car materials used in interchange.

Replies received manifested a great interest by the mechanical officers in this important subject and the committee is of the opinion that considerable progress can now be made in following up the various operations by visiting reclamation plants.

It is recommended that this committee serve indefinitely as a regular committee until rules and regulations governing methods of reclamation and tolerances allowed on reclaimed material be agreed upon and submitted for approval of both Divisions. The report is signed by:

Division VI Representatives: I. C. Bon (Chairman), superintendent of reclamation, Wabash, Decatur, Ill.; G. W. Lieber, superintendent of reclamation, Missouri-Kansas-Texas, Parsons, Kans.; A. L. Prentice, supervisor of scrap and reclamation, New York Central, Cleveland, Ohio; W. P. Stewart, superintendent of scrap, Illinois Central, Chicago.

Division V Representatives: G. H. Davis, foreman reclamation plant, Pennsylvania, Conway, Pa.; D. C. Reid, ass't. chief mechanical officer, Boston & Maine, Boston, Mass.; L. R. Wink, assistant superintendent car department, Chicago & North Western, Chicago.

Overloading Axles

Vice-Chairman Ayers: A day or so ago, one of the member lines called attention to a practice that is creeping in of loading cars of grain in excess of the limit prescribed by Rule 86, the load limit stencilled on the car. It appears that certain railroads have established arbitrary limits, through their traffic departments, in one instance allowing a five percent increase loading, and in other instances an arbitrary of 3,000 lb. That was referred to the General Committee for an opinion, which was expressed as follows:

> It was the unanimous opinion of the General Committee of the Mechanical Division that the road limits prescribed in the interchange rules are based on the best engineering information available and should be adhered to from a safety standpoint. These limits are based on the calculated strength of the axles, allowing a proper factor of safety. Other car parts and truck parts might also be overstressed should these limits be exceeded.

Attention should also be directed to the fact that in connection with Rule 86 there is a provision where trucks or bodies of cars are not sufficient in strength to permit loading the car to the full capacity of the axles, the car owner should arbitrarily fix the limit which it is safe to handle with the individual car, and stencil that load limit on the car for the guidance of the shipper.

These axles are calculated within safety limits of stress for extreme conditions. That is, there is a proper allowance for impact, and for the bending action caused by the pressure of the flange against the rail on the curve and by added load on the outer journal, due to the centrifugal action of the car, and that is figured to a point where the car is just on the point of overturning. You can probably overload 999 out of 1,000 axles and never hear from them at all, but you cannot afford to take chances.

The Division should support the action of the General Committee in such form that it may go to the Board of Directors of the American Railway Association, if anyone desires to make such a motion.

Mr. Garber: I move that the convention approve the action of the General Committee.

The motion was duly seconded and carried.

Attendance and Entertainment

The total registration of railroad men and guests during the convention was 1,386. Of this number 512 were railroad men, 407 were railroad ladies, 299 were railway supply men, and 168, railway supply ladies.

On Tuesday evening, June 25, a reception and dance were held at the Hotel Alexandria. On Wednesday, while the convention was in session an all-day combined motor car and electric railway trip was provided for the ladies to Mt. Lowe. Thursday was given over to an all-day trip to Catalina Island, there being no sessions of the convention on that day. After the close of the convention Friday noon, the members and guests were entertained with a motor tour about Los Angeles and its environs.

At a meeting of the General Committee held during the convention, a decision was reached to hold next year's convention at Atlantic City, N. J., June 18-25, inclusive.

The Reader's Page

Characteristics of Exhaust Steam Injectors

GALVESTON, TEXAS.

TO THE EDITOR:

On page 136 in the March, 1929 issue of the *Railway Mechanical Engineer*, in Part II of the paper on the "Characteristics of Injectors", presented before the American Society of Mechanical Engineers, by R. M. Osterman, vice-president, Superheater Company, T. C. McBride, consulting engineer, Worthington Pump & Machinery Corporation, stated that "180 lb. is the usual boiler pressure in England with but a small portion of the locomotives carrying any higher pressure—it has been generally understood that 180 to 190 lb. boiler pressure is the limiting pressure for the exhaust-steam injector."

This statement, emanating from an authority on the subject, if accepted as authentic by those who are not in possession of the real facts, are apt to be damaging to the future development of the exhaust-steam injector in America. The following data is. therefore, submitted to enable those who may be interested.

During recent years, the railways of Great Britain have built slightly more than 2,000 locomotives having a boiler pressure of 200 lb. or over. Four hundred of these engines carry 225-lb. pressure, while 70, constructed within the past two years, and now handling the heaviest and fastest passenger trains, are worked at 250-lb. pressure. Most of these engines, including practically all of those carrying 220 lb. and over, are fitted with exhaust-steam injectors.

In considering the last part of the statement quoted in the first paragraph, one significant fact should be observed from British practice. The Great Western (England), which has in use more exhaust-steam injectors than any other railway in the world, has also, for many years, employed boiler pressures much higher than were customary on other British railways. The performance of the "King" class of 4-6-0 type locomotives on the Great Western has shown that there can be no question regarding the economy of an exhaust-steam injector with pressures up to 250 lb. Those who are inclined to dispute this, are also advised to consult the data derived from the numerous tests conducted in 1927 by the London, Midland and Scottish on the "Royal Scot" class 4-6-0 type passenger engines.

On page 137 of the same issue, C. T. Ripley, chief mechanical officer, Atchison, Topeka & Santa Fe says that "more level territory at more uniform speeds, less slow-downs, etc.", act distinctly in favor of the exhaust-steam injector. Theoretically, this may be so, but I should like to call attention to one practical example which demonstrates that the exhaust-steam injector may also effect considerable economy under supposedly unfavorable circumstances. I know of no railway in America whose main lines are of a more difficult character than those of the New South Wales Government Railways, where grades of 2.5 and 3.0 per cent, and curves of short radius are encountered. Several years ago, after long experience with about 600 exhaust-steam injectors, the chief mechanical engineer of this system said in the course of a paper read before a prominent Australian engineering society: "Davies and Metcalfe injectors on these railways have shown a fuel economy of 12 per cent and a water saving of 18 per cent."

So much emphasis has been placed on the use of exhaust-steam injectors in Great Britain, that many persons may be unaware of their extensive employment on larger locomotives elsewhere. It will perhaps be remembered that Germany was required to deliver a large number of steam locomotives to the allied nations, shortly after the armistice in 1918. Many of the 1,820 Prussian locomotives delivered to Belgium were equipped with a standard form of closed feedwater heater, which was adopted by the Prussian-Hessian State Railways as early as 1915. These heaters promptly created an unfavorable impression in Belgium, principally due to the expense of keeping them in order. The Davies and Metcalfe exhaust-steam injector was later applied to some hundreds of Belgian locomotives, ranging in size up to 4-6-2 and 2-10-0 types, having a maximum capacity of 2,700 hp., and it has given satisfaction.

The exhaust-steam injector is not in the experimental stage. It is now, and has been for some time, in practical use on five continents, but its permanent adaptation to American conditions cannot take place if the question of fuel saving is allowed to obscure every other factor. Certainly, feedwater heaters and exhaust-steam injectors are primarily installed to save fuel, but too many mechanical engineers are prone to view the subject exclusively from a thermal standpoint, and to forget that fuel costs do not represent the total expense of locomotive operation. The railway viewpoint, which must consider initial costs, with the resultant interest and depreciation charges, is often entirely ignored. European experience indicates that the first cost of a feedwater heater is at least twice that of an equivalent exhaust-steam injector, while a still higher ratio applies to maintenance expenses.

In comparing any two competitive devices, designed to accomplish fuel economy in steam locomotives, the lessons of past experience should teach that a greater fuel saving on the part of one may often be entirely offset by a lower maintenance cost, lower interest and depreciation charges and greater reliability of the other.

WM. T. HOECKER.

Misleading Advertisements

CHICAGO, ILL.

TO THE EDITOR:

We hear a great deal at present concerning "Truth in Advertising." This should not only apply to wearing

apparel, medicine, etc., but also to the expected performances of any tool or device advertised to perform some specific operation at a great saving of time.

Recently the writer received some advertising describing a certain fixture which would enable us to save considerable time, stating that the ordinary standard method of performing this particular job required 40 min.

As a matter of fact, to do this job, which includes the setting up and machining complete floor to floor, requires but 18 min. in our shop. Now how can one expect to save 40 min. in doing a job which only takes 18 min. under the established conditions?

Perhaps some of your readers would like to express themselves on this subject.

DRILL HAND.

Is there a Future for the Engineering Graduate?

STATE COLLEGE, PA.

TO THE EDITOR:

I have read the recent editorial entitled "Is There a Future with the Railroads?". Many engineering students are asking the same question.

In so far as technical graduates in mechanical engineering are concerned, the answer lies very largely with the railroads. Out of sixty-one companies which recently interviewed, or have written for, our thirty-nine seniors in mechanical engineering at Penn State, but two inquiries have come from the railroads. The students probably assume that the railroads have nothing to offer. Moreover, I have before me letters from three recent graduates who intended to stay in railroad work, but who now inquire if we know of any desirable openings in the general field of mechanical engineering for which they may be fitted.

If the railroads will make it evident that in their business the oncoming engineer will have an opportunity equal to that offered by other industries to utilize every faculty of his mind and personality toward attaining a place of reasonable responsibility within a few years, the railroads should be able to secure the best products of the technical schools. For the mechanical graduate the answer to your editorial question is "Yes" if the railroads can prove that they offer real opportunities It is unquestionably "No" if the present situation continues to exist.

It is high time that those who have this question at heart should speak plainly and that the officers who are in a position to determine the policies should do something about it. If the railroads are indifferent, why should the colleges be concerned?

A. J. WOOD,
Professor of Mechanical Engineering,
The Pennsylvania State College.

New Conditions Call for New Type of Leadership

OMAHA, NEB.

TO THE EDITOR:

Your editorial "Is There a Future with the Railroads?" published in the April issue is worth further comment. There are few bloodless revolutions. The revolution in railroad practice which is taking place is accompanied by the usual daily casualty lists. On the other hand, there are few of the supervisors today, particularly in shops, who would want to give up their new tools and new methods, and go back to the old conditions of getting out work without proper maintenance equipment.

Railroad supervision today calls for a new type of leadership and a new type of ability. Modern industrial methods are being applied to railroad shop problems in so far as practical work is being planned with a degree of precision undreamed of a few years ago. Instead of every job being a rush job or an emergency job, orderly procedure is desired and expected in present-day programs.

The study of costs and the determination of methods based on real costs studies is gradually leading to order and efficiency.

You were entirely correct in emphasizing the mental unrest which is always created in such a transition period. The silver lining is found in the fact that when stabilization again takes place, the very conditions which have made the transition necessary will have developed the fact that a higher type of supervision is required under the new and stabilized conditions. Supervisors will be paid more nearly in line with what their accomplishment is worth, there will be a swing of the pendulum, and there will be more supervision rather than less supervision. Consequently, supervisors will have more regular hours and more leisure time. Those who survive the transition are going to have better jobs under more favorable conditions.

Under the new conditions opportunities for the promotion of men of merit are going to be much greater than in the past. Definite yardsticks are being set up to measure the performance of supervisors. A man's work is recorded on the basis of real accomplishment, and he will obtain credit in proportion to the results of his efforts. Motor trains, motor busses, truck lines, and problems of air transportation will all offer new fields of activity for those supervisors who are ambitious beyond the confines of their departmental work.

The stresses and strains which have occurred during the transition period have developed many men to a remarkable degree. The prospects of the future should hold forth compensation for the trials of the transition period.

D. C. BUELL,
Director, The Railway Educational Bureau.

That Question of Free Service

NEW YORK.

TO THE EDITOR:

Your editorial in the April, 1929, *Railway Mechanical Engineer* on "The Question of Free Service," in which you "panned" the railroad mechanical department officers for expecting too much free service from the machine-tool builders, needs to be taken with a grain of salt.

Let me ask you a question: What else can the railroads do? With the exception of axle and wheel lathes a few boring and turning machines and perhaps a grinding machine, I would like you to name some machine tools that are specially designed for railroad shop work. Most of the tools the railroads buy are first designed for machining parts for automobiles, oil and Diesel engines, or, in many cases, for tools used by the

blame the manufacturers much if production shops are where the machine-tool market is. However, why blame the poor railroad man if he has to canvass the builders for the kind of tool that will best lend itself to the use of jigs and fixtures to give the necessary output from his shop.

It seems to me that if the machine-tool manufacturers want to reduce the cost of free service, they should place more tools on the market that are designed for one or more specific jobs in a railroad shop, and then tell the interested railroad officers that such machines are available. Such a procedure would at least alleviate the necessity of "sending bids to five or six manufacturers", and eliminate "the need for that vast amount of engineering service" as was discussed in your editorial.

An Objector.

Is There a Future *with the Railroads?*

New Haven, Conn.

To the Editor:

Your editorial in the April, 1929, *Railway Mechanical Engineer*, entitled "Is There a Future with the Railroads?" describes the situation very fairly. Your conclusions seem to be the same as appear to be gradually crystallizing at all of our Society for the Promotion of Engineering Education and American Society of Mechanical Engineers' conferences with railroad men on this subject; namely, that the requirements for success in railroading depend more upon the individual tastes and personal qualifications of the men entering railroad service than upon their technical training. The nature of the work seems to be such that the emphasis falls more upon these personal qualities than in most other large industrial enterprises.

In other words, the subordinate positions in railroad service, appear to be just about as well filled by the men without technical training as by the men with technical training. The advanced administrative positions, however, seem to require a type of personality which will go further and faster if supplemented by a thorough technical foundation, but which can crash through to a large measure of success in that field with little or no formal technical training.

I believe the college student approaching graduation is keenly alive to this situation, and discriminates rather accurately, on the whole, between industries offering opportunities for advancement up to a reasonably satisfactory job with emphasis upon extraordinary personal qualities, or without such emphasis. Most students have relatively little self-confidence when they face such a situation squarely, and their inclination is to accept the opportunity which appears to offer the most safeguards against possible failure. It is in these directions that railroading as a career is likely to have least attraction for the less adventurous student than other industries which offer more obvious inducements. In the case of the superior student with unusual personal qualifications, all types of industries are, of course, looking for him, and the inducements held out to him by industries other than the railroads are likely to be made especially attractive.

Here again the railroads, as a rule, merely offer the usual chance to take the regular starting job, and hold out no special inducements for him as an individual, so far as future progress is concerned. Hence, the railroads lose at both ends.

S. W. Dudley,

Chairman, Department of Mechanical Engineering,
Yale University.

(Professor Dudley is chairman of Committee No. 25, Relations of Colleges and Railroads, of the Society for the Promotion of Engineering Education.—Editor.)

Encourage the Employees to Read

Pittsburgh, Pa.

To the Editor:

Your editorial entitled "Selecting Useful Information," which appeared on page 229 in the May issue of the *Railway Mechanical Engineer*, discusses a subject that should receive more attention than it does, and also suggests that the employees' magazines, so popular and prevalent on our railroads, could well be made a means of calling attention to the articles in various mechanical magazines that should interest employees in various departments.

For example, the employees in the wheel and tire departments would be especially interested to know that the latest method of heating tires for application to wheels was described on page 244 of the same issue, or those shopmen or engineering department employees interested in the study of locomotive counterbalancing could find a most interesting paper on this subject on page 236.

Should announcement of some new design of machine tool be made in the advertising columns, mention of this too would be of interest. Perhaps some may say this would be a form of free advertising. Even so, does there not appear considerable free advertising of baseball and other sports in the press, which I am sure is of no greater interest to many than the various announcements outlined above would be to a large number or readers of employees' magazines.

Our shop has adopted a plan of placing a rack which will hold in display form about 25 copies of mechanical periodicals. Many copies, after having been read by the subscribers, find their way to this rack which is situated in the center of the shop near the tool wicket. In large letters is painted the following: "Read and Return."

It is very pleasing to the donors to find so many taking advantage of this, rather than perhaps filing these valuable magazines away, only to be sent to the baling department later. Sometimes every copy is out during the noon hour and no attempt is made to keep track of them. If they fail to be returned, it does not matter.

The greater number of our men and boys we can encourage to read and study such subjects as are to be found described in these pages, the more easily will this country be able to keep a step ahead of all other countries in a mechanical way, which will thus ensure a continued era of prosperity for all.

We have found that many bulletins, sample copies, descriptive booklets, all of an advertising nature, which come to our office many times in duplicate, find a very ready reception if placed within reach of our shop employees. These, containing much informative reading, must accomplish much more the objective intended than were they to be thrown in the wastepaper basket, where altogether too much of such matter goes after but one reading.

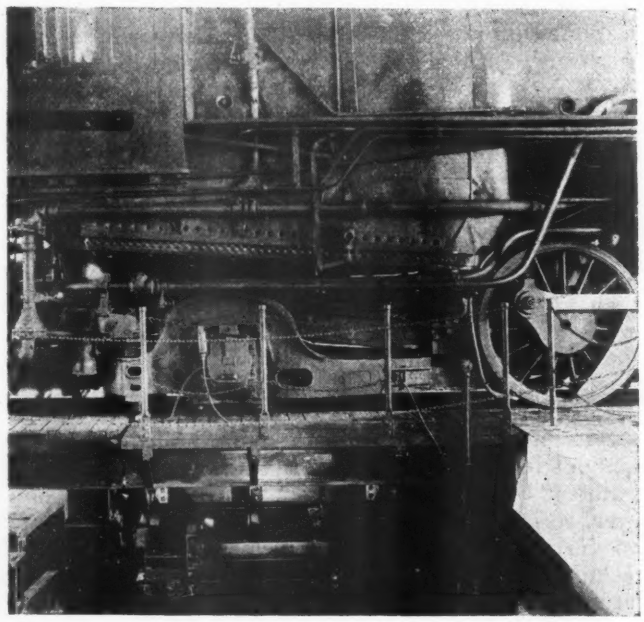
A Reader.

Removing Boosters with a Drop Table

REMOVAL of complete boosters in the drop pit is made possible by an auxiliary device designed and built by Whiting Corporation, Harvey, Ill., for use with its drop table.

The standard size drop table has proved practical for partly lowering the booster to make repairs or inspection as required. The dropping of the complete booster, for removal to the back shop, is not practicable with the ordinary table owing to the projection of the wishbone at the front and the overhang of the booster at the rear. To build a table large enough to handle this job would require such a large pit as to make the cost prohibitive and the length of the table top would constitute a problem when dropping wheels on engines with short wheel bases.

The Whiting Corporation has solved the problem by designing an auxiliary truck which runs in a shoulder of the pit at the end of the drop table. The purpose of the truck is to provide a bridge across the shoulder, and the purpose of the shoulder is to furnish a space into which the overhanging portion of the booster may be dropped when the truck has been pushed to one side.



Auxiliary truck for handling boosters lined up with the pit track

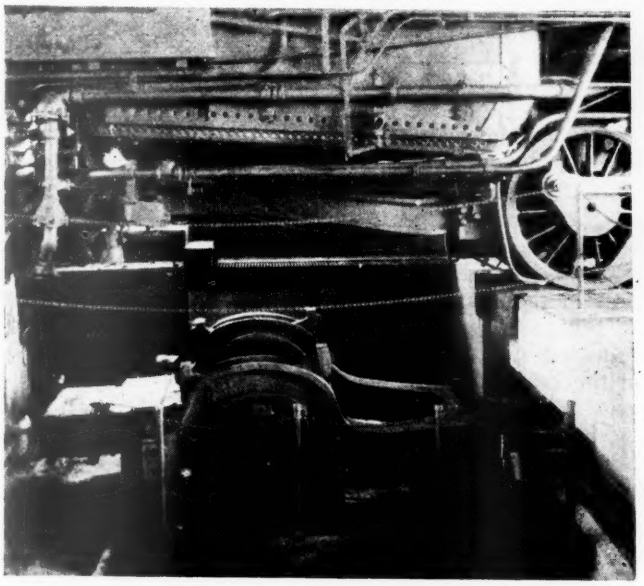
Special truck for handling boosters with the Whiting electric drop-pit table

When a locomotive comes into the enginehouse for a complete booster removal, trailer truck and all, the Whiting table top is raised into position in the stall to be used. Because of the shoulder pit, there is a gap between the table top and the rails of the enginehouse stall on one side of the pit. To fill this gap the auxiliary truck is rolled into place. Its top is locked to that of the table and the whole assembly is locked in line with the enginehouse rails, making a continuous line of track the full length of the stall. The locomotive runs over the auxiliary truck on to the drop table.

When the locomotive is spotted for removal of the booster, no wheels are supported on the auxiliary truck, but above it is the booster and on the drop-pit table are the trailer wheels and trailer frame. The auxiliary truck has served its purpose as a bridge to get the loco-

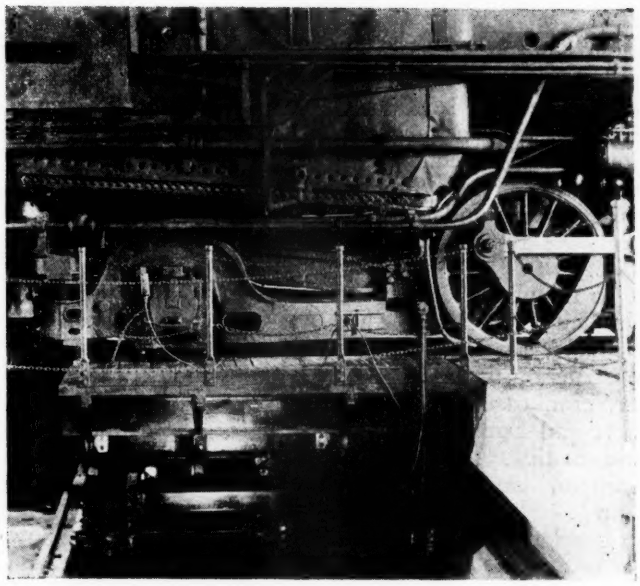
motive over the pit and is now moved to one side leaving nothing to interfere with the dropping of the boosters, the overhang dropping into the special shoulder pit.

The trailing wheels easily clear the locomotive before



Drop-pit table used on a large western road showing the booster dropped in the shoulder of a special pit

the booster has reached the depth of the truck pit so that the drop table may be moved sideways to the stub track located between the stalls of the enginehouse. The top is then raised to the level of the enginehouse rails



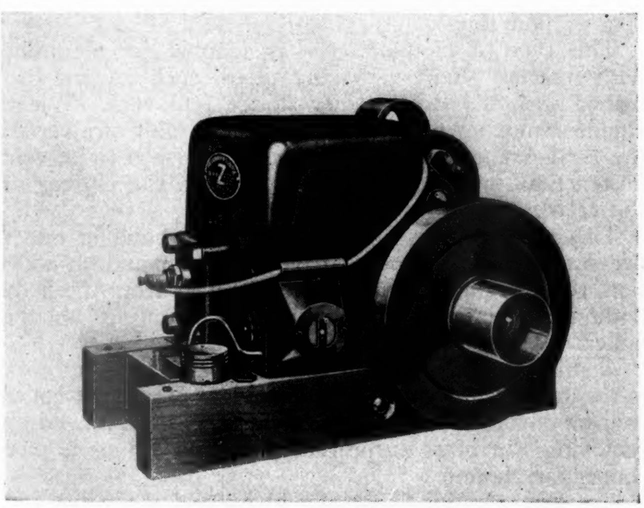
Auxiliary truck of a drop-pit table moved aside to clear the booster

and the auxiliary booster truck rolled into place and locked so that the trailing wheels and booster may be run off the table to the repair track.

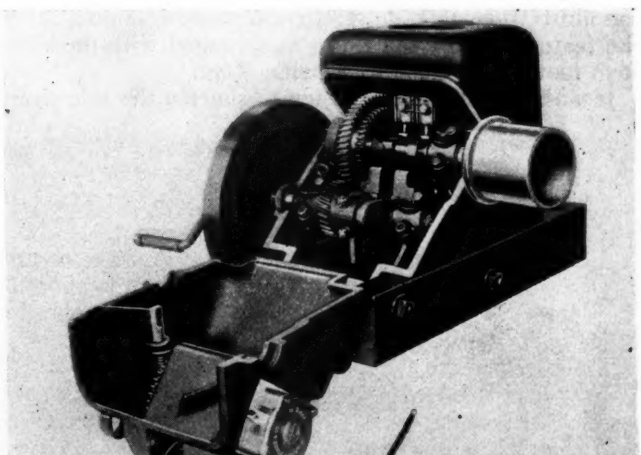
In some instances it has been considered advisable to build shoulder pits on both ends of the drop table to carry the auxiliary trucks. Such an arrangement allows still greater flexibility. This additonal equipment does not in any way interfere with the usual operation of the drop-pit table, such as dropping driving wheels or engine and tender trucks.

Portable Gasoline-Kerosene Engine

A NEW line of gasoline-kerosene engines in rating from 1½- to 7½-hp., recently announced by Fairbanks, Morse & Company, Chicago, has been developed to drive portable pumps, air compressors, saws, grinding wheels, polishers, etc. While the most radical departure from previous construction is in the



This totally enclosed 1½-hp. gasoline engine is only 19 in. wide and 22 in. long



Removal of two bolts permits opening the enclosure and exposes all of the working parts

all-enclosed self-oiling feature, the new engine is quite different in appearance from other small engines of its type.

The 1½-hp. rating, which is a size used in a wide

diversity of light drives, is the most interesting development in the new line. It is less than 16 in. high, 22 in. long and 19 in. wide and weighs 150 lb. Two pulleys are provided, one of which operates at an engine speed of 1,500 r.p.m. and the other at 750 r.p.m. There is also a mechanical regulator which permits slowing the engine down to 1,100 r.p.m. with, of course, proportionate reduction in horsepower. With the two pulley speeds and the speed regulator, it is possible to meet the requirements of almost any type of light drive.

An important feature of the new 1½-hp. unit is its simplicity of design. There are said to be 25 per cent less parts than in previous engines of this size. Unit construction throughout makes the cylinder, water hopper, crankcase and bearing supports for both crankshaft and camshaft integral parts of the cylinder and base casting. The engine, with the exception of the magneto, can be entirely assembled on this base casting.

Complete protection from dirt, dust, rain and snow is afforded through the fully enclosed feature. By the removal of only two bolts all working parts, such as the crankshaft, camshaft, bearing etc., are open to view and inspection. Removal of eighteen bolts completely dismantles the entire engine.

Self-oiling is accomplished through a special lubricating system which drenches all working parts in oil. No grease cups are required. The base casting serves as an oil reservoir. The bearing caps have cups to collect the oil which drips from special baffles located directly above on the crank-case cover.

One of the special mechanical refinements is the method by which leaking of oil is prevented. Felt retainers on the crankshaft and camshaft, return oil grooves on these shafts, and a special crankcase breather are designed to eliminate all possibility of leaking oil. The crankcase breather, further, does away with compression in the crankcase. Instead of forcing the oil out at the gaskets, the special breather draws in all oil collected at the gaskets by maintaining a vacuum within the crankcase.

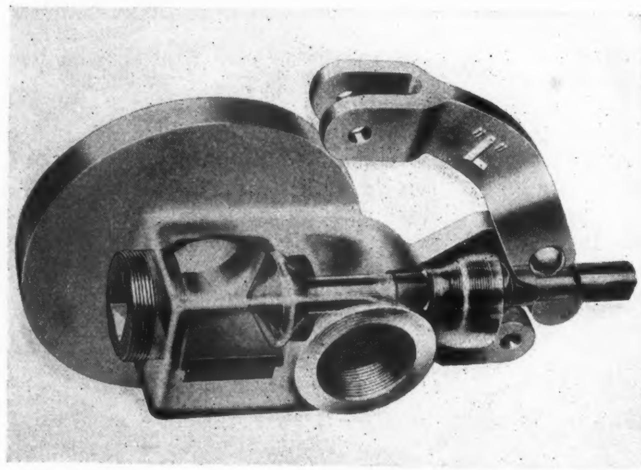
A Blow-Off Cock for Narrow Clearance

THE standard location for locomotive blow-off cocks, whether mounted with or without sludge-removing pipes, is on each side of the firebox near the front or low corners, about one row of staybolts above the mud ring.

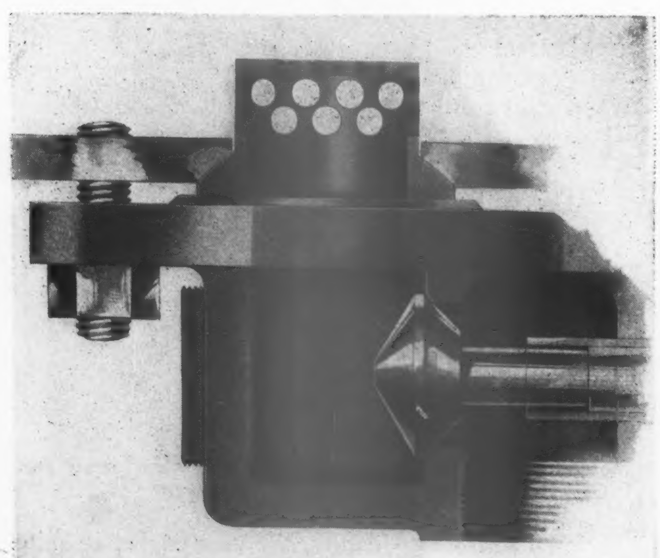
Many of the new locomotives recently designed have, for the purpose of obtaining the largest possible grate area, included fireboxes so wide as to approach the limiting side clearance of the railroads. This makes it of paramount importance that a blow-off cock be used which extends outwardly from the firebox for the minimum possible distance.

With these requirements in mind a new design of blow-off cock, manufactured by the Bird-Archer Company, New York, is now made available. As shown in the illustration, this blow-off cock, while retaining all of the features of the old types, is arranged with the valve stem mounted parallel to the side sheet.

It was possible in this design to shorten the side clearance requirement for the blow-off cock to less than 5 in. This includes the allowance for the fitting of the joint ring in mounting.



The Bird-Archer locomotive blow-off valve for narrow clearances



A sectional view of the valve attached to the locomotive, showing the joint-ring strainer

This type of blow-off cock is adapted for mounting with internal sludge-removing pipes, such as are furnished with the Bird-Archer sludge removers. Where sludge removing pipes are not used, a joint strainer of the Bird-Archer standard design is furnished to prevent obstructions which might interfere with the closing of the valve.

This type of blow-off cock may be ground in under pressure without removing from the boiler and, in addition, the valve and stem may be removed from the body without breaking the ground-joint mounting on the boiler. A plug is provided for this purpose.

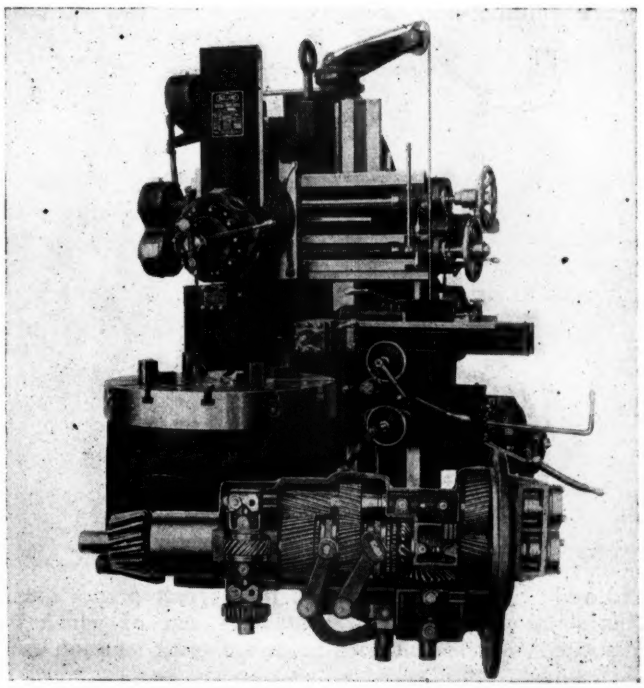
A still further advantage in this type of blow-off cock is the fact that it can be used to blow from two boiler connections at the same time. This may be arranged by removing the brass inspection plug and fitting a pipe connection thereto.

The lever, bushing, packing gland and the valve and stem unit are standard and interchangeable with other blow-off cocks of Bird-Archer design.

Changes in Bullard Vertical Turret Lathe

THE Bullard Machine Tool Company, Bridgeport, Conn., has redesigned its line of vertical turret lathes of the spiral-drive type to assure a margin in their capacity and ability to operate beyond the demands of the latest high-speed cutting materials. Within the past year, spindle speeds have been increased in the manufacturer's specifications and the recommended horsepower for motor drive has been raised with adequate strengthening in construction on the various models from 25 per cent to 40 per cent above previous ratings. This is the result of a period of research and analysis into the requirements of the work encountered and the determination of a method for properly employing the high-speed cutting metals.

It is the opinion of Bullard engineers that the use of tungsten-carbide tools should be based primarily on a selection of those operations to which such tools can be economically applied, together with a determination of the consistent rates of speeds and feeds which will assure a proper life of such expensive tool bits. The nature of face-plate work and the various diameters encountered determine the operations of higher feet per minute which justify the use of such cutting tools while the smaller diameters of necessarily lower feet per minute would not, under simultaneous operation, require more than the regular type of high-speed tools previously available.



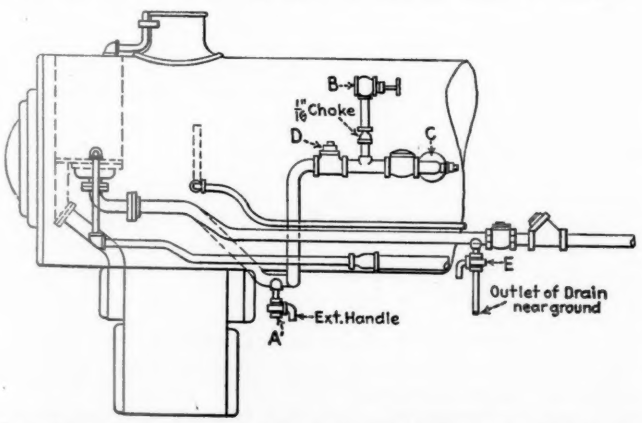
A 42-in. Bullard vertical turret lathe and the redesigned secondary speed-change case

An analysis of the methods involved and the rates of cutting forms an interesting background from which has developed the revision of design in the important drive unit in Bullard vertical turret lathes.

The secondary speed-change case as shown in the illustration is now designed with a complete train of spiral and helical gearing properly balanced or controlled in thrust and providing an extremely smooth and powerful flow of the work under the cutting tools. The rolling action of the spiral and helical gears offers a stronger gear tooth for the same pitch and a more constant flow of power through the driving train to the table. This secondary case, combined with the standard primary of Bullard construction, provides variously eight and twelve different rates of speed through the respective sizes of machines in which it is applied. And the new table speeds obtainable through this unit, though varying with each size of machine, offer reasonable minimum diameters of work at which tungsten-carbide and similar tools can be consistently employed under maximum efficiency of operation.

Cleaning the Coffin Feedwater Heater

TO prevent the formation of scale in its feedwater heater, when operated in bad-water districts, the J. S. Coffin, Jr., Company, 36 Grand avenue, Englewood, N. J., has devised a process, on which patents are pending, which permits the cleaning of the heater at a negligible cost. The equipment, which has been added to the heater and is carried in the locomotive, consists of a tee-connection, two drain valves and a steam valve with a 1/16-in. choke.



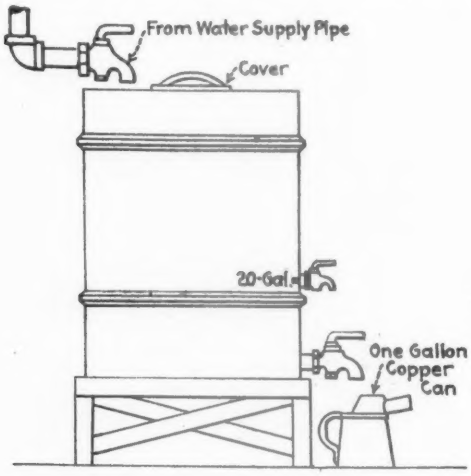
Location on the locomotive of the equipment for cleaning a Coffin feedwater heater

Referring to the illustrations, the water in the branch pipe is drained through the valve *A* after which the valve is closed. The boiler check *C* and the valve *B* are then closed and the plug *D* is removed from the tee-connection. One gallon of cleaning solution is then poured into the branch pipe and the plug *D* is reapplied. The boiler check *C* and the valve *B* are then opened. The drain valve *E*, located in the condensate line, is then opened and the solution is allowed to drain out to the ground until the locomotive is ready to leave the terminal, when the valves *E* and *B* are closed. The pump should not be operated during the cleaning operation.

The condensing steam, fed to the branch pipe through the valve *B*, will force the cleaning solution through the heater discharge line, where the solution is diluted in the

discharge side of the heater. Fron there it gradually works through the heater to the valve E in the condensate line, where it is drained to the ground. No chemicals remain in the system after about one hour.

The solution used consists of cold water, raw muriatic



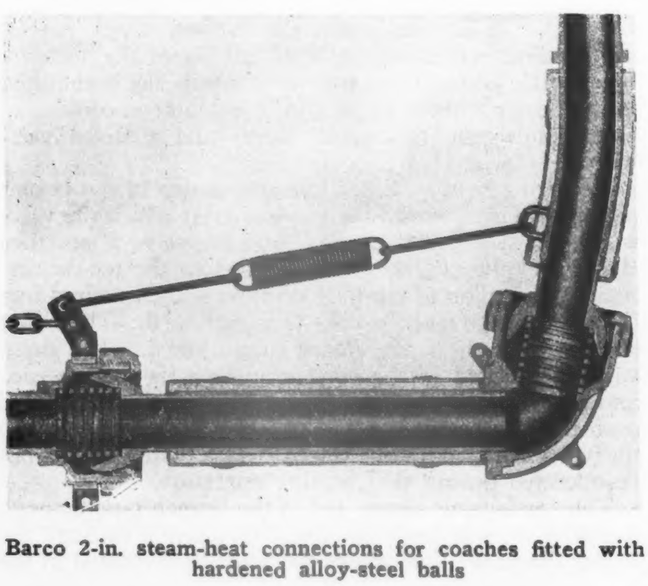
One of the storage containers

acid and "Super Incontrol," in the correct proportions. This solution is stored in containers, one of which is illustrated. Each container holds sufficient solution for 40 cleanings.

Coffin feedwater heater systems equipped with this process are operating in numerous bad-water districts and no trouble is experienced in keeping the heaters free of scale formation.

Barco 2-In. Steam-Heat Connections

SINCE the description of the 2-in. steam heat insulated connections manufactured by the Barco Manufacturing Company, 1801 Winnemac avenue, Chicago, for use between passenger cars and on the rear of tenders, which appeared on page 1490D80 of the June 25, 1928, Daily Edition of the *Railway Age*, several changes have been made in their design. The welding



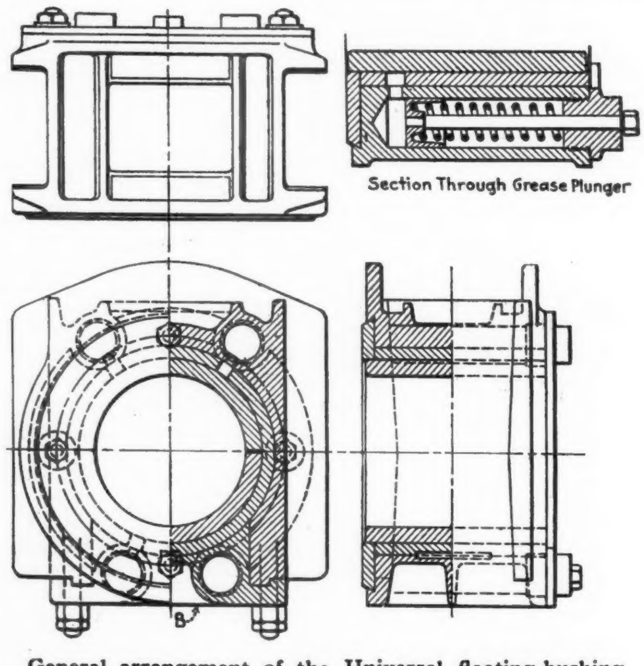
Barco 2-in. steam-heat connections for coaches fitted with hardened alloy-steel balls

of the tubing in the balls has been replaced by rolling the seamless steel tubing into hardened alloy-steel balls similar to the expanding and rolling of a flue into a flue sheet. Drop-forged steel nuts are now used in place of the gasket retainer rings previously used. The change facilitates the replacement of gaskets when necessary.

The new connection is made up almost entirely of drop forgings and seamless-steel tubing, being much stronger than the former castings and allowing repairs to be made by straightening or welding when the connection meets with an accident, instead of having to replace the casting as was formerly the case.

Floating-Bushing Driving Box Changed

A CHANGE in construction has been made by the Locomotive Finished Material Company, Atchison, Kansas, in the Universal floating-bushing driving box since it was described in these pages. The box is now made with the jaws extending the full depth



General arrangement of the Universal floating-bushing driving box

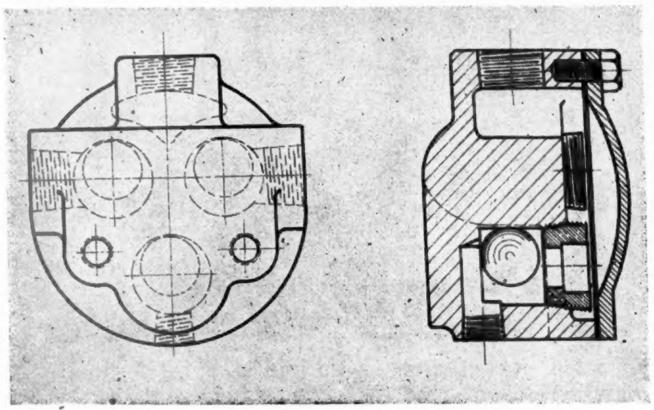
of the box. The space at the bottom of the jaws is filled in with a binder designated as B in the illustration. The binder takes the place of the cellar used on an ordinary crown-brass type of box, but it does not extend to the center line of the box as is common with the grease cellar.

M. M. M. Activities.—"The M. M. M. Family Tree" is a booklet prepared by Manning, Maxwell & Moore, Inc., 100 East Forty-Second street, New York, in order to acquaint those interested with the various branches and products of the M. M. M. organization.

Color Cards.—The Joseph Dixon Crucible Company, Jersey City, N. J., is distributing three new color cards showing Dixon industrial paints for metal and wood protective coatings; utility paints for use on general run of work, and maintenance floor paints for the protection of wood, composition, linoleum, concrete and cement floors.

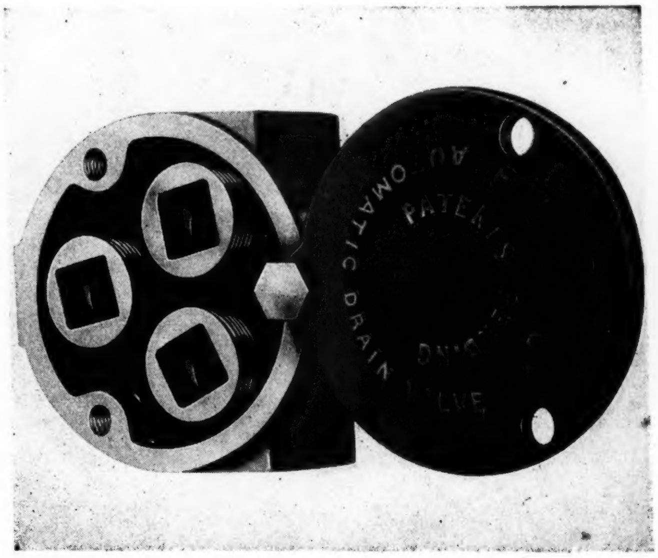
Automatic Drain Valve for Air Compressors

THE Frederick Iron & Steel Company, Frederick, Md., is manufacturing an automatic drain valve for the steam end of cross-compound air compressors. It can be applied to any convenient place beneath the lowest connection by a small bracket held by a nut on the air-compressor head. The two ½-in. pet cocks are removed from the lower end of the steam cylinders and the ¼-in. pet cock is removed from under the main steam-inlet boss. The two ¼-in. pipe taps on each side of the drain valve are connected to the lower end of the steam cylinders and the ¼-in. pipe tap on the top of the drain valve is connected to the main steam-inlet boss. A ½-in. pipe is run from the bottom of the drain valve to any convenient point for drainage.



Sectional view of the drain valve

The operation of the valve is effected by a ball valve as shown in the sectional illustration. The upper port and the two side ports shown in the right view are connected to the drains of the air compressor. The port at the top, which is a ¼-in. pipe tap, is connected to the pocket under the main steam connection. The two side ports, which are tapped for ½-in. pipe, are connected to the bottom of the high- and low-pressure steam cylinders.



Frederick automatic air-compressor drain valve

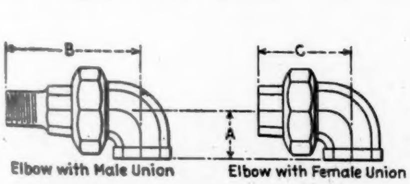
The lower ½-in. pipe tap is to drain the condensation to any convenient place under the locomotive.

When the air pressure in the main reservoir is reduced below a determined point, the governor opens and the air pump starts. There is a certain amount of condensation in the governor and in the steam lines which is caught in a pocket just below the main steam connection.

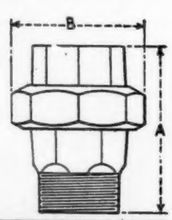
The same applies to the inside of the high- and low-pressure cylinders; condensation forming in the bottom is drained to the valve when the governor opens and the pump starts, the pressure on the balls seat them on the bushing, closing the steam lines of the pump, and when the air pressure is built up to a determined point the governor stops the air pump. With no pressure in the steam cylinders, there is no pressure back of the balls. The balls then fall from the valve seat and what condensation was formed during the operation is drained automatically through the bottom port.

Corley Elbow and Tee Unions

THE Corley-DeWolfe Company, 323 Pine street, Elizabeth, N. J., has recently announced a new line of ball-seat, elbow, tee and air-compressor unions. These unions are made either hexagon or octagon in shape, which permits the use of monkey, spanner, alligator, or pipe wrenches. They are provided with a bronze seat which is a heavy cast ring pressed and expanded into a machined dove-tail recess. This insures a tight seat that will not loosen and is an integral part of the union. The ball end of the union is of malleable iron, machined and ground to a master radius from the center of the circumference of the pipe thread. The collar is undercut so as to permit the installation of the joint where the pipes are slightly out of line. The nut is made extra heavy and is carefully machined to close limits. The collar is turned with a filet which adds extra strength. In making the nut, the hole is first bored and then reamed when the nut is tapped, assuring correct alinement. These unions are designed for steam, water, gas or air and a working pressure of 300 lb. The joint between the bronze seat and the malleable-iron ball end is designed to be used repeatedly without a gasket. It is ground to master gages and not in pairs. All parts are interchangeable.



Size	1/4"	3/8"	1/2"	3/4"	1"	1¼"	1½"	2"	2½"
A	11/16	13/16	1 1/8	1 5/16	1 9/16	1 13/16	2	2 5/16	3 1/16
B	2 5/8	2 31/32	3 5/16	3 9/16	4 1/8	4 9/16	4 5/8	5 15/16	6 11/16
C	1 7/8	2 1/32	2 5/16	2 5/8	2 15/16	3 7/16	3 7/8	4 1/2	5 1/16



Size	1½x1¼"	2x1"	2x1¼"	2x1½"
A	3 15/16	4 1/16	4 1/16	4 1/8
B	3 5/16	3 5/8	3 5/8	3 5/8

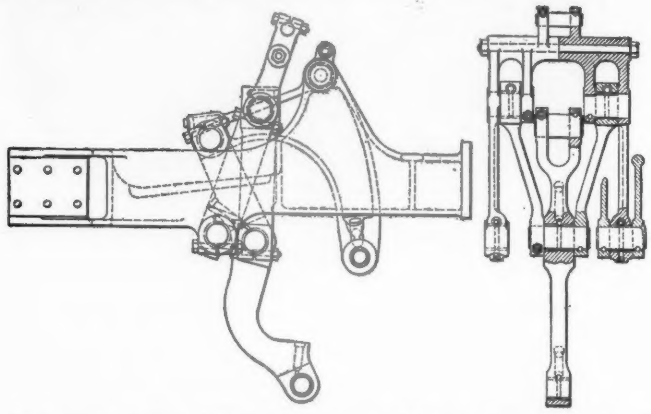
NOTE:—Male end pipe size larger than female end

Left: Union elbows with inside and outside thread—Right: Air Compressor union

Recent Changes Made in Baker Valve Gear

THE illustrations show two major changes made in the Baker valve gear, manufactured by the Pilliod Company, 30 Church street, New York. One of the illustrations shows the general assembly of a Baker valve gear, on which is used a redesigned type of double-arm reverse yoke. The purpose of this design is to eliminate the trunnion at the lower end of the vertical member.

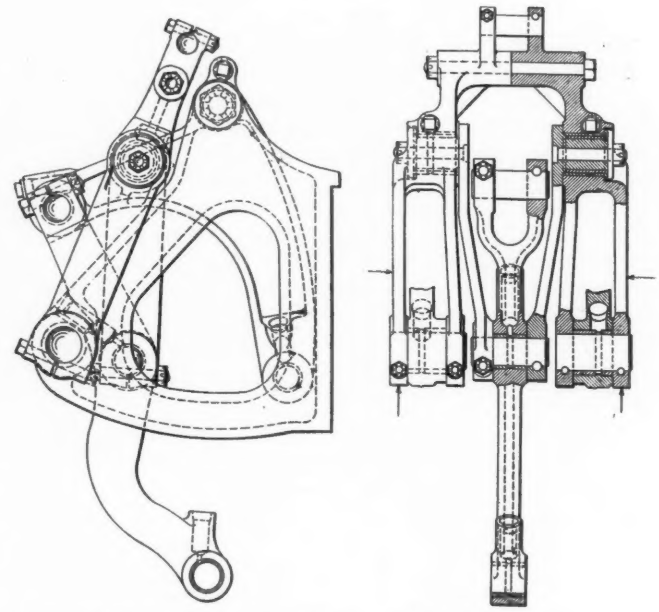
When this part is made of either a casting or a forging there occurs at times a cold shut or porosity at the junction of the trunnion and vertical member which is



The center-hung Baker valve gear—All trunnions have been eliminated in the reverse yoke and radius bar

not discernible in many cases, even after machining, but in subsequent hard usage will sometimes develop a progressive fracture, resulting in ultimate failure of the member.

The double-arm yoke is designed to get away from this entirely, having interchangeability with the present gear parts in view so as to necessitate no further change of other parts. It can be applied to all existing Baker valve gears.



General view of the new design of the double-arm reverse yoke used on the Baker valve gear

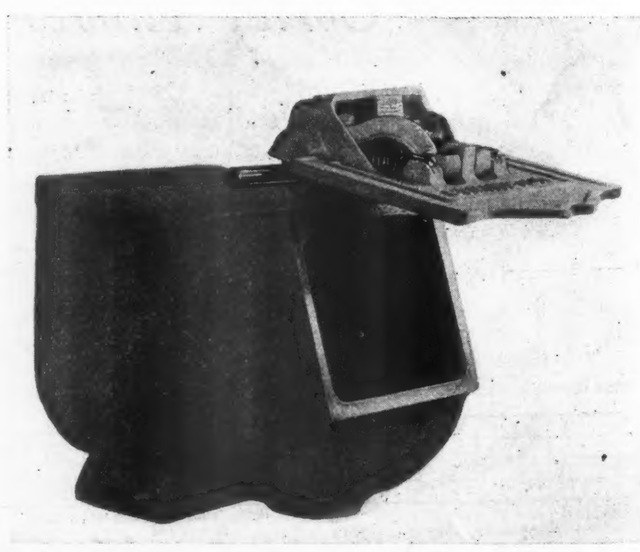
The new type of center-hung valve gear which is illustrated goes a step further in that it eliminates all trunnions both in the radius bars and the reverse yokes. The reverse yoke is a straight member supported in double-shear bearings directly supported within the gear frame and is provided at the top with a similar arrangement in which are hung the radius bars. In both cases it will be observed that the straight pins support these parts in double shear, which is intended to add considerably to the ruggedness of the gear and to retard the development of lateral lost motion.

The existing principles of the Baker valve gear have in no wise been disturbed.

Symington Articulated Lid for Journal Boxes

THE Symington Company, Rochester, N. Y., has developed a design of articulated or self-adjusting journal-box lid in which the lid proper is a malleable casting provided with an integral hinge-lug housing to prevent the accumulation of dirt or water along the top of the lid and box joint surface. The side and top lips or flanges and the interior oil drip, required by the American Railway Association, are also incorporated in the design.

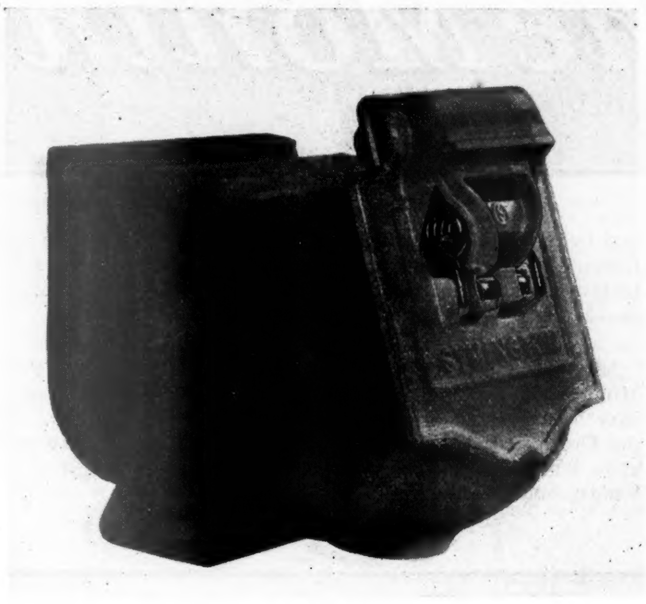
The lid hinge-pin does not pass through the lid proper, which feature permits the necessary articulation or self-adjustability in all directions so that the lid will always remain in uniform contact with the face of the box, regardless of the normal variations in the location of the hinge lug with reference to the box face. The hinge pin is a plain piece of ¾-in. round steel bar, having neither head nor point, and requiring no auxiliary retaining means or riveting to hold it in position. This pin passes through the upper loops of a separate casting known as a spring spider, and this spider is pivoted to the lid proper at approximately its central



Position of the pin and block wood when applying the pin

point. The operating spring is the same double-coiled torsion spring which has been standard with this company for many years.

In the process of assembly of the lid, a small block



Symington articulated journal-box lid

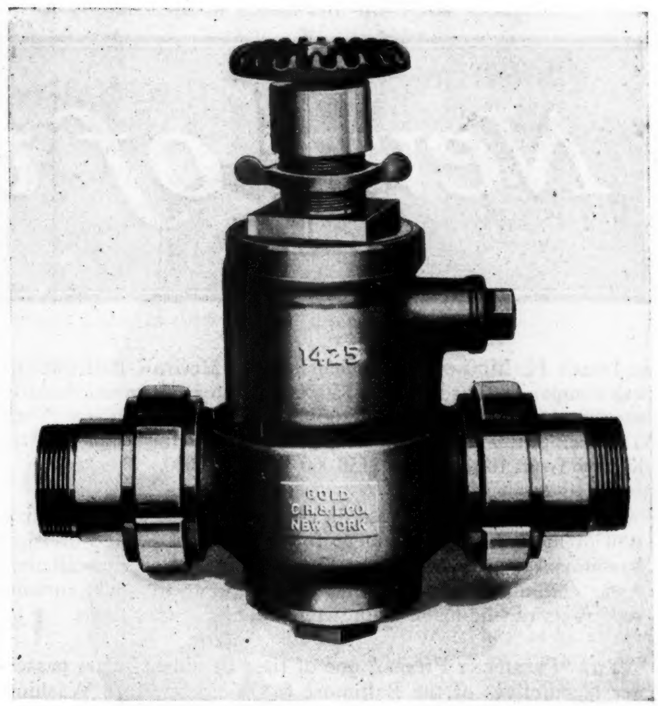
or wedge of wood is driven between the housing and the spring spider. To apply the lid to either an integral or separate box, the lid is simply laid on the top of the hinge lug and the lid pin slipped into position. The lid is then partially closed until the spring wear shoe rests upon the highest point of the hinge-lug cam. When in this position, the small block of wood may easily be removed, after which the lid is closed to service position. To remove the lid from the box, it is merely necessary to reverse the procedure, opening the lid sufficiently to permit driving in a small block of wood or other convenient object, then raising the lid to permit the removal of the pin.

Accidental removal of the lid pin is impossible as the sides of the lid housing extend at each end over one-half the diameter of the pin.

Gold End Valve and Coupling Redesign

THE Gold Car Heating & Lighting Company, Brooklyn, N. Y., has made several changes to its line of steam heat specialties based on information gained from operating experience. A 2-in. locomotive pressure-reducing valve has been designed along the same lines as the 1½-in. regulator valve No. 1014, with double piston rings and with the control valve located in the side of the body for accessibility in cleaning or grinding. To prevent damage to the main body by wear or excessive grinding, the control valve seats against a renewable seat bushing which can readily be replaced.

The 2-in. end valve, No. 1423, has been shortened to give proper clearances to the metallic connections and its rear portion strengthened to care for the weight put upon it by the change from rubber hose. The cam and piston principle of this valve, with but two working parts, greatly simplifies the construction.



Gold 2-in. locomotive pressure-reducing valve

The No. 825-S 2-in. coupler is designed to give a full 2-in. flow of steam throughout, including the gasket orifice. The tension and torsion of the metallic joints to which the couplers are subjected cannot unlock this coupler because of a newly designed self-wedging lock made of carbon steel.

The base of the wedge is considerably wider than the top and, with its housing of similar shape, friction is set up along the entire length of the housing the moment the

Gold 2-in. straight-shank coupler with a redesigned locking mechanism

wedge touches the toe of the opposite coupler in the act of locking. The cotter pin, shown in the illustration, acts as a stop, preventing the wedge from being forced out.

To facilitate the mounting of the coupler, the boss around the inlet has been squared to afford a better grip. The couplers are fitted with gravity condensation relief traps.

News of the Month

JAMES H. McGRAW, chairman of the McGraw-Hill publishing companies, has donated $50,000 to the endowment fund of the library of the United Engineering Society in New York. The committee is endeavoring to increase the fund for the library from the present $150,000 to $2,000,000.

THE NATIONAL OF MEXICO, in connection with the reorganization of mechanical department forces on the Durango division, has moved the repair shops at Durango, Dgo., to Aguascalientes, Ags., confining shop facilities at Durango to such running repairs as can be made in the enginehouse at that point.

THE "PRESIDENT PIERCE," one of the "President" class passenger locomotives of the Baltimore & Ohio, came into Washington, D. C., recently with through passenger train No. 10, having hauled the train through from Chicago, 786 miles. This locomotive is stoker fired. The schedule of this train from Chicago to Washington is 21 hrs., 15 min. From Chicago to Willard, Ohio, 279 miles, the train consisted of 14 cars, and of ten cars for the remainder of the trip.

Bushing Puller Covered by Patents—A Correction

In the April, 1929, issue of the *Railway Mechanical Engineer*, on page 207, appeared a description of a device for applying valve-chamber bushings. Since the publication of this article, our attention has been called to patent papers, 1,689,330 which cover a bushing puller designed by B. E. Delle, an employee of a railroad in the east, in which are covered the fundamental principles of the device described in the April issue of this magazine.

The article was submitted by the author in good faith as he was unaware that this type of bushing puller was covered by patent.

A LUMP of bituminous coal weighing an ounce and two-thirds is sufficient, when used as fuel in a modern locomotive, to move one ton one mile, according to a calculation by J. D. Clark, fuel supervisor of the Chesapeake & Ohio. This is 41.17 per cent less than would have been required on that road during 1923 to move a ton a mile, if freight locomotive efficiency had been no greater in 1928 than it was in 1923.

In other words, the locomotives of the Chesapeake & Ohio, on the average, in 1928 used 102 lb. of coal in moving one mile each 1,000 tons of freight (including cars and lading but excluding locomotive and tender) as compared with 144 lb. per thousand ton-miles in 1923. It there had been no improvement in these five years, the coal needed in 1928 would have been 755,559 tons more than actually was used. Stating his comparison in another way, Mr. Clark calculates that in 1928 one ton of coal was sufficient to move one ton 19,608 miles, whereas in 1923 it moved that weight only 13,889 miles.

Wage Increases

THE BOARD OF ARBITRATION which had been holding hearings in Washington since May 23 on the demand of the shop employees of the Southern for an increase in wages on June 18 issued an award providing for an increase of six cents per hour for about 4,600 of the shop employees and five cents an hour for about 4,400 of them. The board consisted of two elected by the company, two by the shop craft organizations and two selected by the Board of Mediation. The dispute was referred to the arbitration board following mediation by representatives of the board, after the employees had voted to strike on March 31.

Mechanical department employees on the Chicago, St. Paul, Minneapolis & Omaha and the Lake Superior & Ishpeming have been granted a wage increase of five cents an hour. On the Omaha coach cleaners and those mechanics who are paid upon a monthly basis have been granted time and one half for Sunday and holiday work.

Clubs and Associations

THE MACHINE TOOL CONGRESS and the exposition of the National Machine Tool Builders' Association will be held at Cleveland, Ohio, September 30 to October 4, inclusive.

The following list gives name of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal building, New York.

AMERICAN RAILWAY ASSOCIATION DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting, Muehlebach Hotel, Kansas City, Mo., September 10-12.

DIVISION VI—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago. Next meeting, September 11-14, 1929, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio. Annual Convention, September 9-13, Cleveland, O.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting Hotel Sherman, Chicago, October 22-25.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 7836 So. Morgan street, Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. G. Wiegman, 720 North Twenty-third street, East St. Louis, Mo. Regular meeting first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meetings second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—Regular meetings second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS AND CAR FOREMEN'S ASSOCIATION.—See Master Car Builders' and Supervisors' Ass'n.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September at Hotel Hollenden, East Sixth and Superior Ave.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting, August 20-22, 1929, Fort Shelby Hotel, Detroit.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant, Railway Exchange, 80 E. Jackson Boulevard, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash street, Winona, Minn. Convention September 17-20, inclusive.
LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.
MASTER BOILERMAKERS' ASSOCIATION.
MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago. Annual convention September 4, 5 and 6 at the Hotel Sherman, Chicago.
NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston.
NEW YORK RAILROAD CLUB—Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.
PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.
RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—See Master Car Builders' and Supervisors' Association.
RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meetings third Thursday of each month, except June, July and August.
RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.
ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205 Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.
SOUTHWEST MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Master Car Builders' & Supervisors' Association.
TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 24-28, Hotel Sherman, Chicago.
WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

THE CELOTEX COMPANY has moved its offices to 919 No. Michigan avenue, Chicago.

C. A. ANDERSON has been appointed sales manager of the Ford Chain Block Company, Philadelphia, Pa.

W. W. BRICKA, has been appointed general manager of the Goodell-Pratt Company, Greenfield, Mass.

WILLIAM ROBBINS has been appointed district manager, in charge of the Chicago office, of the Chisholm-Moore Hoist Corporation.

THE AMERICAN STEEL FOUNDRIES, Chicago, will spend $500,000 for enlarging its wheel manufacturing facilities at Alliance, Ohio.

J. A. AMOS has been elected vice-president in charge of the sales and service of the Pyle-National Company, Chicago. Geo. E. Hass has been appointed assistant to Mr. Amos.

DOUGLAS W. DODGE has been appointed San Francisco representative of the American Car & Foundry Company with office in the Rialto building, San Francisco, Cal.

H. B. MILLER, formerly manager of the branch office of the Truscon Steel Company at Pittsburgh, Pa. has been elected as vice-president and general manager of the Pacific coast plant and is succeeded by W. H. Kelly of the Chicago office.

OLIVER AMES, senior member of the board of directors of the General Electric Company, died at his home in North Easton, Mass., on June 18. Mr. Ames was 65 years old and had been a member of the board since 1893.

F. S. SHINN, chief lumber inspector of the Chicago, Burlington & Quincy with headquarters at Chicago has resigned to become special representative of the Curtin Howe Corporation.

THE CURTIN-HOWE CORPORATION, New York, has licensed the Pendleton-Gilkey Company, Minneapolis, Minn., to treat forest products of all kinds with the ZMA (Zinc-meta-arsenite) process, at its Spokane, Wash., plant.

THE CHICAGO OFFICE of the American Hoist & Derrick Company, has been moved from the Fisher building to the Engineering building at 205 W. Wacker Drive and the Pittsburgh branch is now located in the Farmers Bank building instead of in the Chamber of Commerce building.

THE LINDE AIR PRODUCTS COMPANY, New York, has opened a new plant at 2603 Floyd street, Louisville, Ky., to produce oxygen to supply the local demand. R. Frye is superintendent of the new plant and W. L. Potts, with headquarters at the Cincinnati plant, is district superintendent.

JOSEPH B. TERBELL, chairman and president of the American Brake Shoe & Foundry Company, New York, has relinquished the duties of president, remaining as chairman of the board and as active executive head of the organization. William B. Given, Jr., vice-president, has been elected president, with headquarters at New York, and Thomas Finigan, vice-president, has been elected first vice-president, with headquarters at Chicago.


William B. Given, Jr.

Joseph B. Terbell was born at Corning, N. Y., in February, 1863 and was graduated from Hamilton College in the class of 1884 with the degree of A. B. He subsequently served with the Fall Brook Railroad, now a part of the New York Central, and later was vice-president of the Corning Iron Works. In 1897 he became president of the Corning Brake Shoe Company and in 1902 was elected vice-president of the American Brake Shoe & Foundry Company, with headquarters at Chicago, in charge of the company's western business. He subsequently served as vice-president at New York. In July, 1919, he was elected president to succeed William G. Pearce, who retired, and in March, 1922, at the time of the death of Otis H. Cutler, Mr. Terbell became also chairman of the board.

William B. Given, Jr., was born on December 7, 1886, at Columbia, Pa., and was graduated from Sheffield Scientific School (Yale) in 1908. Mr. Given began work in the banking business in 1908 and three years later entered the service of the American Brake Shoe & Foundry Company as secretary to the president. In 1916 he became assistant to the president and in May of the following year joined the United States Army and served abroad as captain in the 165th Regiment of the Rainbow division. He returned to the American Brake Shoe & Foundry Company as assistant vice-president of the sales department in May, 1919, and since January, 1921, served as vice-president with headquarters at New York.

Thomas Finigan, who has been elected first vice-president, has also had his jurisdiction extended over various company activities. He was born at Paterson, N. J., on September 26, 1882. In 1897, he entered the mechanical department of the Consolidated Traction Company at Newark, N. J. (now the Public Service Co-ordinated Transport) and later became assistant master mechanic, which position he held until 1902, when he entered the mechanical department of the United Railways at San Francisco, Cal. In 1906, he was in charge of rehabilitation work following the earthquake. Subsequently, he served as purchasing agent and assistant general manager, which position he held until 1915, when he resigned to become Pacific Coast manager of the American Brake Shoe & Foundry Company, with headquarters at San Francisco. In 1918, he was elected vice-president at Chicago. In 1920, he was also elected president of the American Brake Shoe & Foundry Company of California, and in 1927 president of the American Brake Materials

Corporation. Besides being a director in these latter three companies, he is a director of the following subsidiaries: the American Malleable Company, the American Manganese Company, the Southern Wheel Company, the American Forge Company and the Ramapo-Ajax Corporation.

THE BROWN & SHARPE COMPANY has been organized to take charge of the sale of machinery and tools manufactured by the Brown & Sharpe Manufacturing Company of Providence, R. I., with offices in the following cities: Chicago—626 Washington boulevard; Cincinnati, Ohio—814 Chamber of Commerce building; Cleveland, Ohio—424 Penton building, and Detroit, Mich. —500 Curtis building.

JOHN S. LEMLEY, former vice-president of the Viloco Railway Equipment Company, Viloco Machine Company and the Okadee Company, has sold his holdings in these companies and is now associated with the Chas. R. Long, Jr., Company as vice-president, with headquarters at Louisville, Ky. The office formerly occupied by the Viloco Railway Equipment Company, the Okadee Company and the Chas. R. Long, Jr. Company at St. Louis, Mo., has been closed.

HENRY W. WENDT, president of the Buffalo Forge Company, died on June 12 at the age of 67. During his entire business life Mr. Wendt was connected with the Buffalo Forge Company which was established in 1878 by his late brother, William F. Wendt. The company at first manufactured blacksmith forges, but later engaged in the manufacture of fans and heating apparatus. It was in connection with the manufacture of fans and other sheet metal products that Mr. Wendt first became active in the development of punches, shearers and bar cutters and later the Buffalo bending roll. Mr. Wendt was the first president of the National Association of Fan Manufacturers, was one of the founders of the Hydraulic Association, and a member of the American Society of Heating and Ventilating Engineers, the American Society of Mechanical Engineers, and other engineering and trade associations. He was also president of the Buffalo Steam Pump Company, the Geo. L. Squier Manufacturing Company, and the Canadian Blower & Forge Company.

H. W. Wendt

THE SOUTHERN WHEEL COMPANY has moved its headquarters from the Grand Central Terminal building, to 230 Park avenue, New York City. S. C. Watkins, formerly special representative, has been elected vice-president and retains his office at 818 Munsey building, Washington, D. C. S. F. Pryor, Jr., formerly a representative, has been elected vice-president, with headquarters at the general offices, New York, and H. S. Russell, formerly a representative, has been appointed district sales manager, with office at 1414 McCormick building, Chicago.

THE FAFNIR BEARING COMPANY, New Britain, Conn., manufacturers of ball bearings, will enter into the railway equipment field through the recent purchase of the Railway Motors Corporation, De Pere, Wis., who have been for many years the makers of the Melcher railway roller journal bearing, which has been in use on a number of railroads in the West and Middle West for some time. The Fafnir Bearing Company will manufacture the Melcher box; for the present the manufacture will be conducted at the Railway Motors Corporation plant at De Pere but production will ultimately be concentrated in New Britain. L. W. Melcher, designer of the bearing, will continue to have charge of sales and service with headquarters at Chicago. The Fafnir Bearing Company has been specializing in bearing productions since 1911.

EDWARD L. RYERSON, JR., vice-president and general manager of Joseph T. Ryerson & Sons, Inc., Chicago, has been elected president to succeed Joseph T. Ryerson who remains a member of the board and continues to hold the office of treasurer. A. M. Mueller has been elected assistant secretary and a member of the board of directors; H. B. Ressler succeeds Mr. Mueller as general manager of sales; Robert C. Ross has been appointed assistant to the president in charge of plant operations; Wm. H. Bryant becomes Chicago sales manager in charge of country and city store sales; Guy H. Rumpf succeeds Mr. Ressler as manager of the St. Louis plant, and Harry W. Treleaven has been elected assistant treasurer and will continue to be responsible for office management.

Edward L. Ryerson, Jr.

Edward L. Ryerson, Jr., was born in Chicago on December 3, 1886, and graduated from Sheffield Scientific School (Yale) in 1908, later attending Massachusetts Institute of Technology. In 1909 he entered the employ of the Ryerson Company, working in the plant operating department and holding the position of works manager for several years prior to the war. He entered military service early in the war with the Aircraft Production Board in Washington and was later captain in the Air Service division of the Signal Corps. At the close of the war he re-entered the employ of the Ryerson company and in 1922 was elected vice-president. In 1928 he was elected vice-president and general manager. Mr. Ryerson is a member of the board of trustees of the University of Chicago and a director of the Northern Trust Company and the Quaker Oats Company.

Personal Mention

General

OLIVER P. REESE, who has been appointed general superintendent of the Southwestern division of the Pennsylvania, with headquarters at Indianapolis, Ind., has been in the service of that railroad for 29 years. He was born at Louisville, Ky., on May 29, 1876, and graduated from Purdue University in 1898. In August of that year he began his railway career as an apprentice on the Louisville & Nashville, later entering the service of the Pennsylvania at Allegheny, Pa., as a draftsman. From September, 1900, to January, 1917, Mr. Reese served successively on the Pennsylvania as a special apprentice, a gang foreman, foreman of tests at the locomotive testing plant at the Columbian exposition at St. Louis, Mo., a motive power inspector, a general division foreman, a master mechanic, and an assistant en-

Oliver P. Reese

gineer of motive power. He was then promoted to superintendent of motive power of the Central system of the Pennsylvania, Lines West of Pittsburgh, at Toledo, Ohio. On March 1, 1920, he was transferred to the North Ohio division, with headquarters at the same point, and on March 15, 1921, to the Illinois division at Chicago. He was promoted to assistant general superintendent of motive power of the Northwestern region at Chicago on January 15, 1924, and became superintendent of motive power of the Eastern Ohio division on April 1, 1925. Later Mr. Reese was promoted to general superintendent of motive power of the central region, with headquarters at Pittsburgh, Pa. He is now general superintendent of the Southwestern division.

R. B. Watson, has been appointed assistant engineer of tests of the Erie, with headquarters at Meadville, Pa.

K. T. Miller, assistant mechanical engineer of the Erie, at Cleveland, Ohio, has been appointed engineer of tests, with headquarters at Meadville, Pa., succeeding R. B. Watson.

H. W. Jones, master mechanic of the Pennsylvania at the Juniata shops at Altoona, Pa., has been promoted to superintendent of motive power of the Western Pennsylvania division to replace R. H. Flinn.

Shop and Enginehouse

M. H. Arms has been appointed enginehouse foreman of the Union Pacific, with headquarters at Tekoa, Wash.

L. K. Spafford, general foreman of the St. Louis-San Francisco at Neodesha, Kans., has been transferred as general foreman to Fort Worth, Tex.

E. F. Tuck, general foreman of the St. Louis-San Francisco at Fort Worth, Tex., has been transferred as general foreman to Kansas City, Kan.

C. Gresham, general foreman of the International-Great Northern, at Fort Worth, Tex., has been transferred to Freeport, Tex.

C. L. Christy, enginehouse foreman of the International-Great Northern at Houston, Tex., has been appointed general foreman, with headquarters at Forth Worth, Tex.

M. S. Lewis, general foreman of the Wheeling & Lake Erie at Brewster, Ohio, has been appointed superintendent of shops, succeeding E. W. Scheuffler.

J. J. Prendergast, night enginehouse foreman of the Texas & Pacific at Fort Worth, Tex., has been promoted to the position of erecting shop foreman, with headquarters in the same city.

E. W. Scheuffler, formerly superintendent of shops of the Wheeling & Lake Erie at Brewster, Ohio, has been appointed general foreman, in charge of all the enginehouses on the system.

Master Mechanics and Road Foremen

George M. Boh has been appointed district road foreman and fuel supervisor of the Erie, with headquarters at Hornell, N. Y.

C. L. Sengel has been appointed master mechanic of the Owensboro division of the Louisville & Nashville.

George Twist, master mechanic of the Revelstoke division of the Canadian Pacific at Revelstoke, B. C., has been transferred to the Winnipeg Terminal division, to succeed A. J. Pentland.

F. S. Kelly, master mechanic on the Texas & Pacific at Texarkana, Tex., has been appointed assistant master mechanic of the Fort Worth division at the same point.

Frank C. Ferry, master mechanic of the Louisville, Henderson & St. Louis, with headquarters at Cloverport, Ky., has resigned following the taking over of this railroad by the Louisville & Nashville.

Palmer R. Mitchell, general foreman on the Louisville & Nashville at Ravenna, Ky., has been promoted to master mechanic at that point.

T. C. Baldwin, master mechanic of the New York, Chicago & St. Louis with headquarters at Stony Island, Chicago, has been transferred to Conneaut, Ohio, where he will have jurisdiction over the entire Nickel Plate district. The position of master mechanic at Stony Island, Chicago has been abolished.

A. J. Pentland, master mechanic of the Winnipeg terminal division of the Canadian Pacific at Winnipeg, Man., has been transferred to the Kenora division at Kenora, Ont.

P. S. Mock, foreman in the office of the electrical engineer of the motive power department of the Long Island Railroad, has been promoted to the position of assistant master mechanic succeeding G. S. Webb.

Frank A. Leavitt, master mechanic of the Second division of the Oregon-Washington Railroad & Navigation Company, has been transferred to Spokane, Wash., to succeed T. H. Yorke, deceased.

W. L. Gorton, assistant supervisor of fuel and locomotive operation of the Erie at New York, has been appointed district road foreman and fuel supervisor, with headquarters at Secaucus, N. J.

L. W. Shirley, district foreman of the Oregon-Washington Railroad & Navigation Company at Cheyenne, Wyo., has been appointed master mechanic of the Second division, succeeding F. A. Leavitt.

J. J. Maginn, master mechanic of the Nickel Plate district of the New York, Chicago & St. Louis at Conneaut, Ohio, has been promoted to superintendent of motive power, with headquarters at Cleveland, Ohio. Mr. Maginn was born in New York City on August 15, 1878. He was educated in the public schools of Norwalk, Ohio, and entered railroad service in 1895 as a call boy on the Wheeling & Lake Erie at Norwalk. Later in the same year he became a machinist apprentice. Upon the completion of his apprenticeship in 1898, Mr. Maginn served as a journeyman machinist on the Wheeling & Lake Erie, the Illinois Central and the Chicago Great Western, and in 1906 was promoted to the position of enginehouse foreman of the Lake Erie & Western (now a part of the Nickel Plate) at Indianapolis, Ind. A year later he became enginehouse foreman at the Shelby street enginehouse of the Cleveland, Cincinnati, Chicago & St. Louis at Indianapolis, where he remained until 1911 when he accepted a position as enginehouse foreman on the Baltimore & Ohio at New Castle, Pa. In 1912 he was appointed general foreman of the Cincinnati Northern at Van Wert, Ohio, and in 1914 was appointed master mechanic. In 1919 he became superintendent of motive power of the Lake Erie & Western at Lima, Ohio, and in 1922, when that road became a part of the New York, Chicago & St. Louis, he was appointed master mechanic of the Lake Erie & Western district. He was promoted to the position of master mechanic of the Nickel Plate at Conneaut in 1927.

Purchases and Stores

O. B. Mills, assistant general storekeeper of the Pennsylvania has been appointed assistant to general storekeeper.

Wade N. Kuhn, assistant fuel purchasing agent of the Pennsylvania, has also been appointed an assistant purchasing agent.

E. B. De Vilbiss, superintendent of motive power of the New Jersey division of the Pennsylvania has been appointed assistant stores manager.

G. R. Williams, assistant comptroller of the Spokane, Portland & Seattle, has been appointed purchasing agent, with headquarters as before at Portland, Ore., succeeding Elmo Edwards, who, because of ill health, has been transferred to other duties.

O. V. DANIELS, general storekeeper of the Pennsylvania at Altoona, Pa., has been appointed works storekeeper at the same point.

JAMES YOUNG, supervisor in the purchasing department of the Pennsylvania, has been appointed assistant purchasing agent.

S. A. MONTGOMERY, supervisor in the purchasing department of the Pennsylvania, has been appointed assistant to the purchasing agent.

C. W. KINNEAR, assistant general storekeeper of the Pennsylvania at Altoon, Pa., has been appointed assistant general storekeeper, with headquarters at Philadelphia.

C. L. MCILVAINE, assistant stores manager of the Pennsylvania, with headquarters at Philadelphia, has been appointed assistant purchasing agent.

W. L. OSWALT, assistant general storkeeper of the Pennsylvania at Altoona, Pa., has been appointed assistant works storekeeper with the same headquarters.

G. H. SCHULTZ, assistant purchasing agent of the Pennsylvania at Pittsburgh, Pa., has been appointed assistant fuel purchasing agent at Philadelphia.

E. J. LAMNECK, assistant purchasing agent of the Pennsylvania, at Philadelphia, Pa., has been appointed fuel purchasing agent, with the same headquarters, succeeding B. P. Phillippe, deceased.

Obituary

FRANK W. MORSE, former vice-president and general manager of the Grand Trunk Pacific, the Chicago & Alton and the Toledo, St. Louis & Western, died at New York on May 25. Mr. Morse had been in poor health since his recent return from Europe where he had been engaged in work dealing with the consolidation of railway lines in Central and Eastern Europe. He was born at Lafayette, Ind., December 31, 1864, and was educated at Purdue University, Lafayttee, and at Washington University, St. Louis. He began his career on the Denver & Rio Grande Western and later served successively as assistant master mechanic and master mechanic of the Wabash at Fort Wayne, Ind., the latter being a position at one time held by his father, John Battell Morse. In May, 1896, he became superintendent of motive power of the Grand Trunk and in July, 1901, was appointed vice-president in charge of transportation. Mr. Morse's recommendation to extend the Grand Trunk resulted in the creation of a new coast to coast project incorporated as the Grand Trunk Pacific, of which he was made vice-president and general manager. He established the standards as to low grades and easy curvature that were used in the construction of that line. This improvement in respect to these standards gave the Grand Trunk Pacific an operating advantage over other transcontinental routes built up to the present time and insured to that line many important economic advantages. Mr. Morse resigned from the Grand Trunk Pacific and in May, 1911, became associated with the late Theodore P. Shonts and was appointed vice-president and general manager of the Chicago & Alton and of the Toledo, St. Louis & Western, from which he resigned with the retirement of Mr. Shonts in August, 1912. During the World War he was a member of the United States Council of National Defense. Between 1919 and 1925 Mr. Morse lived in Europe representing American interests and dealing with various governments. The last years of his life he was engaged in negotiations with the governments of Central and Eastern Europe with the view of consolidating their railroads.


Frank W. Morse

T. W. COE, superintendent of motive power of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, who died in that city on May 18, had been connected with the mechanical departments of several railways for nearly 38 years. He was born on December 4, 1879, at Norwalk, Ohio. After attending high school in that city he entered railway service as a machinist apprentice on the Lake Shore & Michigan Southern (now a part of the New York Central) at Norwalk on December 21, 1896. When he had finished a four-year apprenticeship at that point he was advanced to machinist at the Collinwood shops, Cleveland, where he remained until 1901 when he became a locomotive foreman on the Wheeling & Lake Erie at Dillonvale, Ohio. From 1904 to 1916 Mr. Coe served successively on the Lake Shore as passenger enginehouse foreman at Elkhart, Ind., as night general foreman at Englewood, Chicago, as general foreman of both passenger and freight enginehouses at Elkhart and as superintendent of shops at Elkhart. In March, 1916, he was appointed master mechanic of the Indiana Harbor Belt at Chicago where he remained until November, 1917, when he was appointed to a similar position on the Nickel Plate at Conneaut, Ohio. Mr. Coe had been superintendent of motive power of the Nickel Plate since January, 1927.


T. W. Coe

HARRY D. VOUGHT, secretary of the New York Railroad Club and the Central Railway Club, died at his home on Montclair, N. J., on June 3. Mr. Vought was born in Buffalo, N. Y., on August 14, 1849. He was educated in the public schools of that city and entered newspaper work in May, 1868. He became city editor of the Buffalo Evening Post in 1872 and from 1876 to 1897 was a reporter, assistant city editor and railroad editor of the Buffalo Courier. He then became railroad editor of the New York Commercial, remaining in that position until 1918, when he retired from active newspaper work. In addition to his newspaper work, Mr. Vought was actively associated with various clubs and organizations. He served for approximately 50 years as secretary and treasurer of the Central Railway Club. He was also secretary of the New York Railroad Club, having served in that capacity continuously since 1903. Since 1907 he was associated with the Master Boiler Makers' Association in a similar capacity.


Harry D. Vought